Mexican Gray Wolf Husbandry Manual

2009 Edition

MEXICAN GRAY WOLF HUSBANDRY MANUAL:

GUIDELINES FOR CAPTIVE MANAGEMENT

Mexican Wolf Species Survival Plan©

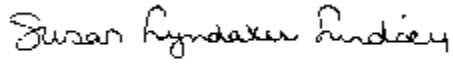
2009
http://www.fws.gov/southwest/es/mexicanwolf

ACKNOWLEDGEMENTS

The Mexican Wolf Species Survival Plan© and the U.S. Fish and Wildlife Service would like to thank the following contributors for their assistance in the creation and updating of the Mexican Gray Wolf Husbandry Manual:

- 1995 MWSSP Management Group for an earlier edition of the husbandry manual.
- Dr. Susan Lyndaker Lindsey and Kim Scott of the Wild Canid Survival and Research Center in St. Louis for the initial rewrite of the husbandry manual as the MWSSP Keeper Training Workshop Manual.
- Elizabeth Quandt-Evans of the Wild Canid Survival and Research Center in St. Louis for her work on the 2003-2004 rewrite.
- Dr. Susan Lyndaker Lindsey and the MWSSP Management Group and its advisors for the 2006-2007 update of the manual.
- Cover photo: 2008 litter of SB572 and SB685 at one week of age taken by Wild Canid Center staff member Julie Tasch. Litter totaling eleven pups was the result of early induced ovulation research. All rights reserved by the Wild Canid Survival and Research Center.

The 2009 edition of the Mexican Gray Wolf Husbandry Manual is a living document and will be updated as new information becomes available. The Mexican Gray Wolf SSP Management Group expresses its sincere gratitude to the many individuals who have contributed their time and expertise to the care and recovery of this endangered species.



Susan Lyndaker Lindsey, Ph. D.
Wild Canid Survival and Research Center
MWSSP Behavior and Husbandry Advisor

TABLE OF CONTENTS

List of Figures

List of Appendices

INTRODUCTION

There are two important documents that are used as guidelines for the management of the Mexican gray wolf SSP©. The first of these is the Mexican Wolf International Studbook. This studbook is a compilation of the vital records of the entire historic captive population of the Mexican gray wolf subspecies. Included are all the births, deaths, and transfers that have occurred in the history of the subspecies, as well as the family lineages.

Each wolf is assigned its own individual studbook number by the studbook keeper. By utilizing the information contained in the studbook, the captive population can be managed in a scientific manner that allows both genetic and demographic goals for the preservation of the subspecies to be met. The studbook is maintained on a computer program known as SPARKS.

The second document important to the management of the Mexican gray wolf SSP© is the Mexican Wolf Husbandry Manual. It is a set of guidelines based upon the best current scientific knowledge for the maintenance and propagation of the subspecies in captivity. Contained within it is information on housing and enclosure requirements, behavior and social organization, reproduction, nutrition, and veterinary care and medical concerns.

The guidelines in the husbandry manual benefit the subspecies in a number of ways. They provide consistency among participating institutions and make it easier to transfer wolves between institutions. Standardized practices allow easier detection of potential health and husbandry problems. Good husbandry allows us to more easily achieve our genetic and demographic goals by providing more efficient and predictable breeding, as well as allowing us to preserve the natural behaviors necessary for wolves that may eventually be reintroduced to the wild.

SSP© Management Group

D. Peter Siminski MWSSP Coordinator and International Studbook Keeper
The Living Desert
47-900 Portola Avenue
Palm Desert, CA 92260-6156
PH: 760-346-5694, ext. 2103
FX: 760-568-9685
Email: psiminski@livingdesert.org

John Kiseda MWSSP Vice-Coordinator
El Paso Zoo
4001 East Paisano Drive
El Paso, TX 79905-4223
PH: 915-521-1865
FX: 915-521-1857
Email: kisedajj@elpasotexas.gov

Linda Moore MWSSP Secretary
Animal Care
Smithsonian National Zoological Park
P.O. Box 37012 MRC 5507
Washington, D.C. 20013-7012
PH: 202-633-3210
FX: 202-633-8727
Email: moore@si.edu

Dusty Lombardi MWSSP Treasurer
Columbus Zoological Garden
P.O. Box 400 (9990 Riverside Drive)
Powell, OH 43065-0400
PH: 614-645-3458
FX: 614-645-3465
Email: dusty.lombardi@columbuszoo.org

Susan Lyndaker Lindsey, Ph. D. MWSSP Husbandry and Behavioral Advisor
Wild Canid Survival and Research Center
P.O. Box 760
Eureka, MO 63025-0760
PH: 636-938-5900 or 6490
FX: 636-938-6490
Email: slindsey@wildcanidcenter.org

John Linehan
Stone Memorial Zoo
Stoneham, MA

c/o Zoo New England
One Franklin Park Road
Boston, MA 02121-3220
PH: 617-989-2054
FX: 617-989-2025
Email: jlinehan@zoonewengland.com

Terry Lincoln
Dakota Zoo
P.O. Box 711
Bismarck, ND 58502-0711
PH: 701-223-7543, ext. 4
FX: 701-258-8350
Email: director@dakotazoo.org

Rick Janser
Albuquerque Biological Park
903 Tenth Street, SW
Albuquerque, NM 87102
PH: 505-764-6224
FX: 505-764-6281
Email: rjanser@cabq.gov

Vonceil Harmon
Oklahoma City Zoo
2101 NE 50th Street
Oklahoma City, OK 73111-7199
PH: 405-424-3344, ext. 232
FX: 405-425-0207
Email: vharmon@okczoo.com

Roberto Wolf
Zoológico de Tamatán
Calle Ursulo Galván #250 esq. Rí0 Bravo
Col. Tamatán
87060 Cd. Victoria, Tamaulipas
Mexico
PH: (+52-834) 318 14 92 / 312 00 86
FX: (+52-834) 312 00 86
EM: rwolf@zootamatan.org

USFWS Mexican gray wolf Website
http://www.fws.gov/southwest/es/mexicanwolf

SSP© Advisors

Jorge Servin — Presidente del Subcomité Técnico Consultivo Nacional Para la Recuperacion del Lobo Mexicano
Universidad Juarez del Estado de Durango
Instituto de Ciencias Sociales
Privada de Aquiles Serdan y Predio Canoas S/N
Col. Los Angeles: C.P. 34000
Durango, Durango
Mexico
Email: loboservin@yahoo.com

Xóchitl Ramos Magaña — Vocal de Manejo en Cautivario de Subcomité Técnico Consultivo Nacional para le Recuperacion del Lobo Mexicano
Zoológico "Alfonso L. Herrera" del Bosque de Chapultepec
Dirección General de Zoologicos de la Ciudad de Mexico
Av. Chivatito s/n
1a Sección del Bosque de Chapultepec
Col. San Miguel Chapultepec
11859 México, D.F.
Email: xramoslupus@hotmail.com

Maggie Dwire — USFWS Advisor
U.S. Fish and Wildlife Service
Mexican Wolf Recovery Program
2105 Osuna NE
Albuquerque, NM 87113
PH: 505-761-4783
FX: 505-346-2542
Email: maggie_dwire@fws.gov

Susan Lyndaker Lindsey, Ph. D. — Husbandry and Behavioral Advisor
Wild Canid Survival and Research Center
P.O. Box 760
Eureka, MO 63025-0760
PH: 636-938-5900 *or* 636-938-6490
FX: 636-938-6490
Email: slindsey@wildcanidcenter.org

Cheryl Asa, Ph. D. — Reproductive Advisor
Saint Louis Zoo
One Government Drive
Saint Louis, MO 63110-1395
PH: 314-646-4523
FX: 314-646-5534
Email: asa@stlzoo.org

Jacquelyn M. Fallon — Education Advisor
Wild Canid Survival and Research Center
P.O. Box 760
Eureka, MO 63025-0760

PH: 636-938-5900 *or* 636-938-6490
FX: 636-938-6490
Email: jfallon@wildcanidcenter.org

Michael J. Richard, DVM — Veterinary Advisor
Albuquerque Biological Park
903 Tenth Street, SW
Albuquerque, NM 87102-4029
PH: 505-764-6262
FX: 505-764-6275
Email: mrichard@cabq.gov

Carlos Sanchez, DVM — Veterinary Advisor
Animal Health
Smithsonian National Zoological Park
P.O. Box 37012 MRC 5502
Washington, D.C. 20013-7012
PH: 202-633-3193
FX: 202-673-4733
Email: sanchezca@si.edu

Edward Spevak, Ph. D. — Small Population Management Advisory Group Advisor
Saint Louis Zoo
One Government Drive
St. Louis, MO 63110-1395
PH: 314-646-4706
Email: spevak@stlzoo.org

Linda Munson, D.V.M., Ph. D. — Pathology Advisor
Dept. VM-PMI, Haring Hall
School of Veterinary Medicine
University of California
Davis, CA 95616
PH: 916-754-7963
FX: 916-752-3349
Email: lmunson@ucdavis.edu

VACANT — Nutrition Advisor

Jack Grisham — AZA Canid TAG Chair
Saint Louis Zoo
One Government Drive
St. Louis, MO 63110-1395
PH: 314-646-4629
Email: grisham@stlzoo.org

CHAPTER 1:
SPECIES SURVIVAL PLAN (SSP©) FOR THE MEXICAN GRAY WOLF

Mexican Wolf SSP© Mission Statement:

The mission of the Mexican gray wolf Species Survival Plan© is to support the reestablishment of the Mexican wolf in the wild through captive breeding, public education, and research.

Mexican Gray Wolf - Listing and Recovery Planning:

In 1976, the Mexican gray wolf, *Canis lupus baileyi*, was listed as endangered under the Endangered Species Act (ESA), which requires the U.S. Fish and Wildlife Service to develop and implement recovery plans for the conservation and survival of listed species. In 1979, the Mexican Wolf Recovery Team was formed and prepared the Mexican Wolf Recovery Plan. This plan was approved in 1982 and contains the following objective:

"To conserve and ensure the survival of *C. l. baileyi* by maintaining a captive breeding program and reestablishing a viable, self-sustaining population of at least 100 Mexican wolves in the middle to high elevations of a 5,000-square-mile area within the Mexican wolf's historic range."

In 2003, when the USFWS restructured the Endangered Species listing of the gray wolf, the Mexican gray wolf within the Southwestern Gray Wolf Distinct Population Segment was still considered endangered. Also in 2003, the service convened a new Recovery Team to revise the outdated 1982 Recovery Plan. The new plan will contain delisting and downlisting goals. The team is currently on hold and it is uncertain as to when the new plan will be completed.

Under a joint agreement between the United States and Mexico, five Mexican wolves were captured from the wild in Durango and Chihuahua, Mexico between 1977 and 1980. In 1995, two additional lineages of captive gray wolves were genetically determined to be Mexican gray wolves and added to the captive breeding program.

What is a Species Survival Plan or SSP©?:

The Species Survival Plan (SSP©) began in 1981 as a cooperative population management and conservation program for selected species in zoos and aquariums in North America. Each SSP© manages the breeding of a species in order to maintain a healthy and self-sustaining captive population that is both genetically diverse and demographically stable. SSP©s also participate in a variety of other cooperative conservation activities, such as research, public education, reintroduction and field projects.

The SSP© Master Plan:

An SSP© Master Plan outlines the goals for the population. It designs the "family tree" of a particular captive population in order to achieve maximum genetic diversity and demographic stability. Breeding and other management recommendations are made for each animal with consideration given to the logistics and feasibility of transfers between institutions, as well as maintenance of natural social groupings. Often, Master Plans include recommendations not to breed animals, so as to avoid having the population outgrow the available holding space.

How Species are Selected:

A species must satisfy a number of criteria to be selected for an SSP©. Most SSP© species are endangered or threatened in the wild and have the interest of qualified professionals with time to dedicate toward their conservation. Also, SSP© species are often "flagship species", well-known animals which arouse strong feelings in the public for their preservation and the protection of their habitat.

The Husbandry Manual:

Many SSP©s have developed husbandry manuals, which set guidelines based on the best current scientific knowledge for the diet and care of the species in captivity. With standardized practices, it is easier to detect potential health and husbandry problems. In addition, because the guidelines provide consistency among participating institutions, it is also easier to transfer animals between institutions when necessary.

The Studbook:

Studbooks are fundamental to the successful operation of SSP©s, as each contains the vital records of an entire captive population of a species. With appropriate computer analysis, a studbook enables the species coordinator and management group to develop a Master Plan that contains sound breeding recommendations based on genetics, demographics, and the species biology.

References (Referencias):

Anonymous. AZA Fact Sheet: Species Survival Plan. 1995. American Zoo and Aquarium Association Conservation and Science Office. Betheseda, MD.

D. Peter Siminski and Edward M. Spevak. 2008. Population analysis and breeding plan: Mexican wolf (*Canis lupus baileyi*) Species Survival Plan. 24-25 July 2008. Association of Zoos and Aquariums.

CHAPTER 2:
POPULATION MANAGEMENT

Historical Perspective - Population Lineages:

Five wolves, (four males and one pregnant female) were captured from the wild to form a captive breeding program between 1977 and 1980 by Roy McBride in Durango and Chihuahua, Mexico. These five wolves were then transferred to the U.S. where three (one female and two males) became the founders of a certified captive breeding program for a species that was on the brink of extinction. Known as the McBride lineage, the population had grown to 107 animals by 1995.

In July 1995, two additional lineages of captive Mexican wolves, the Ghost Ranch population in the United States and the Aragon population in Mexico City, were approved for addition to the SSP© breeding program. The Ghost Ranch lineage is derived from two wolves taken from the wild in 1959 and 1961. The Aragon lineage is derived from two wolves originating at the Chapultepec Zoo in the mid 1970s. Although both lineages had been maintained in captivity since at least the 1960s, they were previously uncertified because of uncertainties about their origins. However, genetic investigations concluded that all three lineages were pure *Canis lupus baileyi*. Findings revealed that the McBride lineage had the lowest level of inbreeding and had retained the most founder alleles, while the Ghost Ranch lineage had a high level of inbreeding and the fewest founder alleles. The study also confirmed the McBride lineage to have only three founders versus the four previously assumed (one of the wild caught males was the offspring of the wild caught female).

Findings from this research recommended that the three lineages be combined to increase the number of founders and to postpone any inbreeding depression. The addition of these two lineages added 4 new founders and 33 individuals (25 Ghost Ranch, 8 Aragon) to the total captive population. [For more information regarding the three lineages of Mexican gray please see Appendix A.]

Genetic Diversity - Carrying Capacity - Generation Time Management:

The overall goal set by the 1994 SSP© Master Plan is to preserve 75% of the gene diversity in captivity for 50 years. The Master Plan projects a need for 240 wolves in captivity to achieve the genetic goals. The calculated 2006 gene diversity of the captive population was 82.41% (the amount of original genetic variability or heterozygosity retained within the population) and the founder genome equivalents was 2.84. The founder genome/population is a small number of individuals, originating from a large population, that form the basis of a new, independent (isolated) population of that species. These are slight increases over the previous year. Additionally, the mean inbreeding coefficient (0.1497) is a slight decrease from the previous years. Inbreeding

occurs when two related individuals breed with each other ("consanguineous breeding"). Inbreeding results in an increase of homozygosity "by descent". The probability of becoming homozygous by descent is called the inbreeding coefficient. The closer the common ancestors are to the parents in the pedigree, the higher the inbreeding coefficient, and the higher the proportion of loci at which the offspring will become homozygous by descent. These improvements in the genetic picture of the captive population are primarily the result of careful merging of the three Mexican wolf lineages over the past eight years.

In order to maintain gene diversity, the Master Plan projects a need for a captive carrying capacity of at least 240 wolves. However, the lack of sufficient captive space continues to be of concern for the program, especially considering the carrying capacity does not include wolves surplused for the reestablishment effort. As a means of creating more captive space, the SSP© and its counterpart in Mexico (Subcomite Tecnico Consultivo Nacional para la Recuperacion del Lobo Mexicano) continue to aggressively promote participation by North American Zoos and their like in the captive breeding program. Another way to maintain or even increase the gene diversity is by increasing the number of founders. However, finding new founders seems unlikely: except for the reintroduced population, the presence of wolves in the wild has not been confirmed for more than fifteen years. Although 81% of the genetic diversity of the population has been retained, it can be increased by managing the captive population better. One management practice is to increase the generation time, the longer the generation time, the smaller the loss of genetic diversity. Semen collection and cryopreservation is one way to increase generation time, assuming artificial insemination techniques are perfected.

Management Strategies:

1. The first priority is to breed individuals of the lowest Mean Kinship (MK) which are under-represented and, therefore, possess the rarest alleles in the population.
2. Among individuals with low MK, the second priority is to breed those individuals whose alleles may be lost soon. Priorities should be determined by the manager's knowledge of an individual's age, health, and/or reproductive condition. In the absence of other information low Kinship Value (KV), printed on the Master Plan report, can be used.

Criteria for Establishing Breeding Pairs:

There are five criteria that are considered in order during the establishment of annual breeding pairs for the Mexican wolf captive population (in order of priority):

1. Mean Kinship Value: Mate individuals with roughly similar MK to avoid combining rare and common alleles in offspring that reduces long term gene diversity.
2. Inbreeding Coefficient: Mate individuals whose offspring will have low inbreeding coefficients (F), for the best probability of viable, healthy offspring.

3. Biology of Individual: Maximize mating success based on the species' biology, including suitable age of individuals, mate choice, social structure, reproductive history, etc.
4. General Logistics: Minimize logistical difficulties of moves (e.g. distance, cost, quarantine).
5. Politics: Maximize interinstitutional harmony and minimize political conflicts.

It has been recommended that special attention be given to the behavioral characteristic of the individual given how much this criterion weighs on the success of the release candidate. Wolves that are potential candidates for release to the wild are evaluated based on a number of behavioral and physiological criteria including genetic makeup, age, reproductive performance, proven parental skills and appropriate social behavior, and aversion to humans.

Rationale for Deciding the Location for SSP© Recommended Pairings:

As the SSP© captive population has matured to carrying capacity, there will be fewer breeding opportunities for the many institutions involved with the holding and exhibition of Mexican wolves. Also the SSP© population is still considered the primary source of Mexican wolves that may be used in future reintroductions, and there will likely be future introductions. For the above situation and the above need, the SSP© seeks to not only minimize the loss of gene diversity in the captive population over time, but also to:

- Optimize the reproductive success and the predictability of success for our recommended pairings.
- Optimally use the limited space within the SSP© institutions.
- Minimize domestication.
- Minimize wolf habituation to human presence.
- Optimize those behavioral characteristics that result in success in reintroduction.

To these ends, it needs to be recognized that the SSP© has a preference for placing recommended breeding pairs in those institutions that have the capacity and flexibility for multigenerational wolf pack management. The SSP© also has a preference for placing breeding pairs in institutions that have off-exhibit breeding and holding, and demonstrated wolf management expertise. The SSP© always seeks to be fair and equitable in offering wolf breeding opportunities to the holding institutions, but with the above goals in mind.

Hand-Rearing:

As a rule wolf pups are only removed for hand-rearing in extraordinary circumstances and with prior approval of the USFWS. The genetic value of the pups will need to greatly outweigh the domesticating influences of hand-rearing. However, when approval has been granted for hand-rearing, see Chapter 9 and Figure 9-B for the recommended protocol.

References (Referencias):

D. Peter Siminski. 1994. 1994 Mexican Wolf SSP© Master Plan. American Zoo and Aquarium Association. Oglebay, WV.

D. Peter Siminski and Edward M. Spevak. 2008. Population analysis and breeding plan: Mexican wolf (*Canis lupus baileyi*) Species Survival Plan. 24-25 July 2008. Association of Zoos and Aquariums.

CHAPTER 3:
GENERAL BIOLOGY - NATURAL HISTORY - REINTRODUCTION

Population Status:

The Mexican gray wolf (*Canis lupus baileyi*), or "lobo", is the rarest, southernmost, and most genetically distinct subspecies of the North American gray wolf. The lobo was extirpated from the southwestern United States by the mid 1900s due primarily to an aggressive predator control program implemented by the federal government. International wolf experts rate recovery of the Mexican gray wolf as the highest priority of gray wolf recovery programs throughout the world. As of 1 January 2007, 291 Mexican gray wolves are in 48 captive facilities in the United States and Mexico, and there are nine packs in a reintroduced population in Arizona and New Mexico.

Natural History:

Wild populations of Mexican gray wolves were exterminated before they were extensively studied; therefore much of their natural history remains to be learned. The average Mexican gray wolf weighs 50-80 lb (25.8-36.24 kg), is 4.5 to 5.5 ft (135-165 cm) in total length (nose to tip of tail), stands 28-32 in (70-80 cm) at the shoulder and has a richly colored coat of buff, gray, rust, and black. They mate sometime between late January to mid March, and have a gestation of 63 days with an average litter size of 4-5 pups. Wolves have complex social behaviors, living in family groups called "packs", the structure of which is maintained by communication through vocalizations, body postures, and scent marking. Wolves play an important role in the ecosystem that is not filled by other predators. Like all gray wolves, lobos evolved as a predator of large hoofed mammals. Their tightly organized group structure enables them to work cooperatively to bring down prey much larger than themselves. However, because the primary prey of the Mexican gray (deer) is smaller than the moose and caribou hunted by northern wolves, wolf pack sizes were probably smaller as well. A typical pack may have been five to six animals consisting of an adult pair and their offspring, with a territory encompassing up to several hundred square miles.

Historic Range - Habitat Preference:

Mexican gray wolves were found in a variety of southwestern habitats; however, they were not low desert dwellers. They preferred mountain woodlands, probably because of the favorable combination of cover, water, and available prey. The lobo inhabited wooded foothills, mountains, and riparian corridors from central Mexico through southeastern Arizona, southern New Mexico and western Texas (see Appendix B and Figure 3-A).

Reasons for Decline:

In the early 1900s high cattle stocking rates coupled with overhunting of deer and elk by humans, resulted in many wolves preying on livestock. This led to intensive efforts to eradicate wolves in the United States. Wolves were shot, trapped, and poisoned by both private individuals and government agents. By the mid-1900s, Mexican gray wolves had been effectively eliminated from the United States, and Mexican populations were severely reduced. Over the next 20 years dispersing wolves from Mexico were occasionally caught and killed in the U.S. There have been no confirmed reports of naturally occurring Mexican gray wolves in the U.S. since 1970, and no confirmed reports in Mexico since 1980.

Reintroduction Objectives (as quoted from the 1982 Mexican Wolf Recovery Plan):

1. Establish a captive population of 240 animals with at least 17 breeding pairs.
2. Reestablish a wild population of at least 100 animals within the wolf's historic range.

Reintroduction Area:

Wolf reintroduction has occurred in one area within the subspecies' historic range. The Blue Range Wolf Recovery Area (see Figure 3-A) includes the Apache and Gila National Forests in eastern Arizona and western New Mexico [(7,000 mi^2); (18,200 km^2)], and also the White Mountain Apache Tribe lands on the Fort Apache Indian Reservation [(2,500mi^2) (6,475km^2)]. (See also Figure 3-B).

The Reintroduction Plan - Soft Release:

The Mexican gray wolf reintroduction project plan is built upon the lessons learned from previous predator reintroduction programs such as the red wolf in North Carolina and Tennessee and the gray wolf in the Northern Rocky Mountains. The plan was to release about 15 pairs or family groups over a period of five years into the Blue Range Wolf Recovery Area. The USFWS predicted that it will take approximately 9 years to establish a self-sustaining population of 100 wolves through release of captive animals and natural reproduction in the wild. Although releases started in 1998, this goal has yet to be realized.

Initially, biologists used a "soft release" approach, which entails holding the wolves in acclimation pens for up to several months before the release. Wolves released into the primary recovery zone in Arizona were allowed to disperse into the secondary recovery zone in New Mexico.

*The Nonessential Experimental Population Rule***:**

The USFWS and cooperating agencies use a flexible "adaptive management" approach based on careful monitoring and research to evaluate and make decisions about recovery

actions. The reintroduction plan allows for wolves to be removed or relocated when conflicts occur with livestock or humans. Selective removal of individuals or packs that habitually prey on livestock increases the potential for wolf recovery to succeed because it encourages a wolf population that focuses on native prey and builds a tolerance for coexistence among livestock producers. Reintroduced Mexican gray wolves are designated as nonessential experimental population under the Endangered Species Act, which allows for greater management flexibility than would be possible if wolves were classified as fully endangered. The rule delineates the population boundary, provides guidance for wildlife managers on capturing, monitoring, and translocating wolves, and defines the circumstances in which a citizen can legally harass or kill a wolf.

Criteria for Selecting Release Candidates:

Personnel working with Mexican gray wolves must not attempt to modify the animals' behavior. As it is difficult to identify which wolves will ultimately be selected for release, avoidance of socialization or familiarization of the wolves with humans is fundamental. Remote feeding is preferred for release candidates and should be employed whenever possible. Feed, give access to the food, and then leave the area. Wolves that are potential candidates for release to the wild are evaluated based on a number of behavioral and physiological criteria including genetic makeup, age, reproductive performance, proven parental skills and appropriate social behavior, and aversion to humans.

For current information on field activities, visit:
http://www.fws.gov/southwest/es/mexicanwolf
Additional information is available through the Arizona Game and Fish Department's Mexican gray wolf website:
http://www.azgfd.gov/w_c/es/wolf_reintroduction.shtml
Past updates may be viewed on either website, or interested parties may sign up to receive updates electronically by visiting:
http://www.azgfd.gov/signup

References (Referencias)/Suggested Readings:

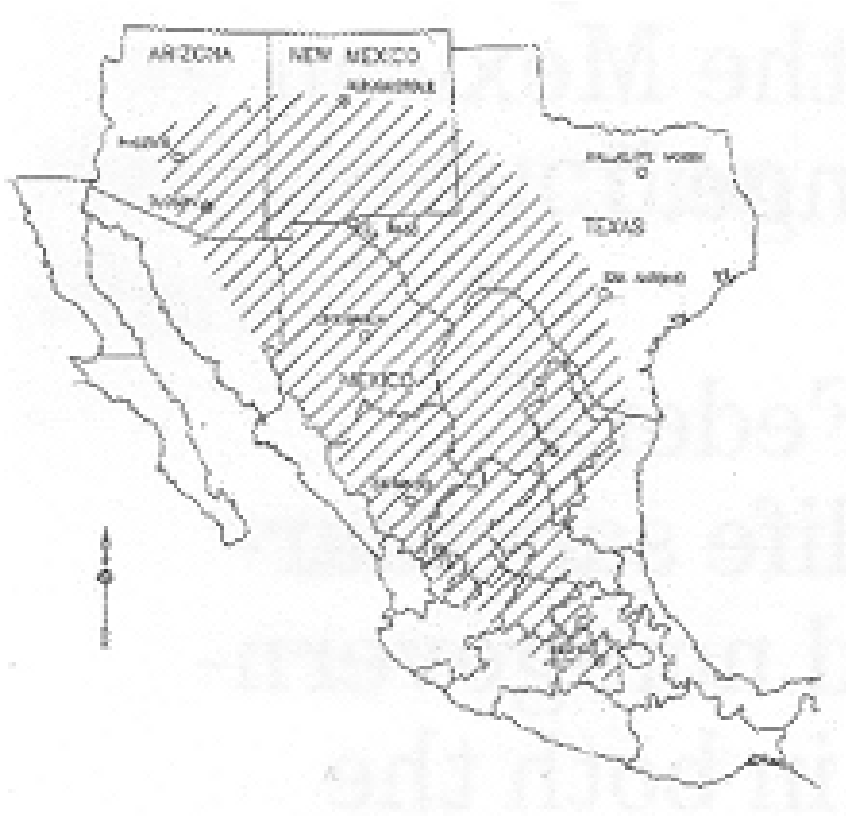
Anonymous. 1997. Mexican Gray Wolf: Challenge in the Southwest. U.S. Fish and Wildlife Service. Albuquerque, NM.

Kent Newton. 1995. Mexican Wolf Husbandry Manual. Mexican Wolf SSP Management Group.

1996. The Mexican Wolf: Natural History and Recovery Efforts. U.S. Fish and Wildlife Service. Albuquerque, NM.

D. Peter Siminski and Edward M. Spevak. 2008. Population analysis and breeding plan: Mexican wolf (*Canis lupus baileyi*) Species Survival Plan. 24-25 July 2008. Association of Zoos and Aquariums.

Figure 3-A Maps of the historic range and the recovery zones of Mexican gray wolf



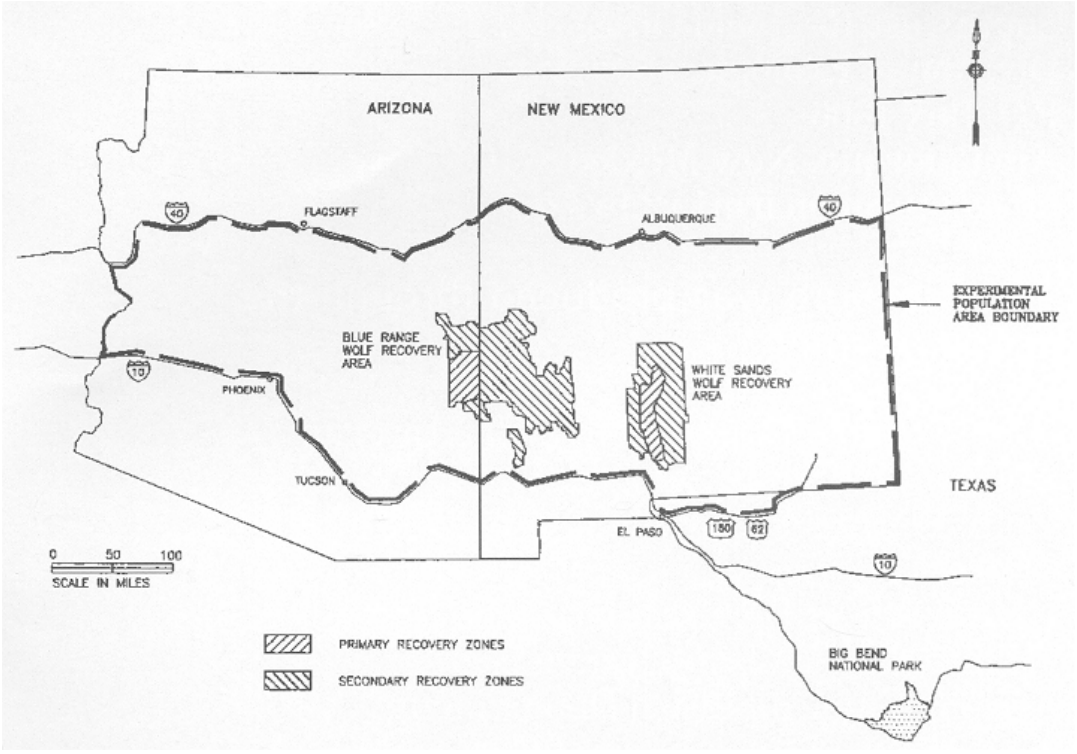


Figure 3-B Important dates in Mexican gray wolf history.

EVENT	**DATE**
Canis lupus baileyi listed as an endangered species.	1976
C. l. baileyi listed as extinct in the wild.	1980
First captive-born Mexican gray wolves released into the wild.	1998
First pups born in the wild.	2001
First wild pairings formed.	2003

CHAPTER 4:
BEHAVIORAL AND SOCIAL CHARACTERISTICS

Optimal Social Groupings:

Canid social behavior has been well documented over the years. Like most canids, the Mexican gray wolf shows a strong affinity to an organized social arrangement. This is normally exhibited in the form of a family group consisting of a dominant breeding pair and their offspring from current or previous litters, or both. Breeding pairs with young-of-the-year or two consecutive litters have proven to be cohesive, advantageous groupings and represent what would be considered an optimal social grouping. It must be cautioned that the variables affecting stress (e.g., exhibit design, management practices, human presence, environmental factors, etc.) are likely to have a more critical influence on a larger multi-generational pack than a same sex, smaller group. However, the benefits of a multi-generational pack are far reaching. The primary litter has the benefit of experiencing and assisting with the growth and development of the secondary litter. The secondary litter likewise can greatly benefit from all aspects of group social interaction (including but not limited to aunting behavior, play, aggression, dominance, submission, vocal communication, and hunting and feeding activities). Many possible combinations of social pairings/groupings exist and may be suitable based on the individual animals, the situation, and on the approval of the Mexican Wolf SSP© Management Committee. For example:

1. adult breeding pair
2. adult breeding pair with offspring from 0 - 1.5 years of age
3. litter mates up to 1.5 years of age
4. same sex packs of either related or unrelated individuals

With regards to same sex packs, there are many factors which should be considered when attempting to form such social groupings. Introductions should occur under close supervision in large areas where each animal has the ability to retreat if feeling threatened. A number of steps can be taken to help encourage the successful formation of same sex packs. These include:

- Providing multiple feed, water, and resting sites so they can not be monopolized.
- Open feeding areas so that all animals feel secure enough to feed.
- Insuring that all areas are open during an introduction (indoors, outdoors) in a manner that provides no opportunity for an animal to be cornered.
- Eliminating bones and raw meat enrichment during the introduction period.

Lock downs and separations serve only to accentuate strife between pack members. If the situation is bad enough that separation is deemed necessary, do not try to put them back together again until well out of the breeding season.

In same sex *female* packs it is very difficult to form unrelated groups. Female pack formation seems to occur more smoothly out of breeding season with siblings or family pack members that have not previously been paired with adult males. It is very important that the pack members be of similar age groups. No matter how long a female pack has been housed together, there may still be aggression problems during the breeding season.

The formation of same sex *male* packs is most successful if all wolves arrive at the same time and are introduced to neutral ground. They should *always* be introduced outside of breeding season, usually in the early fall. Age composition is important among males as well. One older male with the rest of similar age, but no more than two years younger, seems to work best. There has also been success in mixing subordinate males from large family packs into mixed-age same-sex groups.

Animal Introductions and Separations:

Although Mexican wolf introductions are generally uneventful, interactions should be closely monitored for the first few days to get a good idea of compatibility. If possible, giving the animals visual and olfactory contact through a wire fence barrier for a period of time prior to physical access is recommended. Although very few pairs have not been successfully introduced, there have been a few reports in both Mexican and red wolves of a resident wolf reacting to a newly introduced wolf as though it were intruding on an established territory. In addition, there have been reports of females in this scenario dominating an introduced male, which may have resulted in minimizing the chance for successful breeding. Dominance during introductions may be minimized by holding the resident animal in an adjacent holding area and allowing the newly introduced animal access to the enclosure to become familiar with its new surrounding. (For a representation of basic wolf behaviors, see Figures 4-A, 4-B, 4-C, 4-D and 4-E.)

The effects of removal of adults or pups from their parents or separation of adults or adult pairs are highly variable. There have been reports of increased vocalization, pacing, or lack of appetite when well-bonded pairs have been separated and held apart during the breeding season. Other reports have described similar behavior when females have lost a litter or an individual has lost a mate.

Stress:

A key factor in encouraging wolves to breed in captivity is the provision of surroundings in which they feel comfortable and secure. The animals should not be unduly disturbed through the breeding season, whelping, and pup rearing. There should be no major changes in the routine to which the animals have become accustomed. If Mexican gray wolves are managed as "wild" animals, the chances of having successful propagation can be enhanced by providing them with a predictable routine and as much seclusion and privacy as practical. It is also important to keep stress levels at a minimum at all times, as it has been observed that animals that have been stressed throughout the year may not breed during the season.

The trained observer can assess stress levels of wolves that are not afforded sufficient privacy or security. Signs of stress may include: pacing, spinning or twirling, increase in aggression or submission, overgrooming, excessive licking or chewing, diarrhea, hair loss, disease, decreased appetite and/or weight loss, reproductive failure, or maternal neglect. All efforts should be made to allow the animals to exhibit natural behaviors and to restrict human-animal interaction.

Reproduction:

Mating:

Under no circumstances are "uncertified" wolves to mate with "certified" Mexican gray wolves in the SSP© as indicated by the records of the studbook keeper, unless specifically directed in writing by recovery program administrators for identified scientific purposes that aid in the recovery of the species. Mating of certified wolves shall occur only with approval of the SSP© Management Group and the USFWS or SEMARNAT.

Mexican grays are monestrous with mating taking place from the last week of January through April 15th. Gestation is 60-63 days. Average litter size is 4-5 pups with parturition taking place in April or May. Until safe, reliable and reversible contraception has been demonstrated in this species the recommended means of mating prevention remains temporary separation during the relatively short period that the female would be in estrus. These dates are generally from late January through March.

Assisted reproduction and contraception are discussed later in this chapter.

Physical Characteristics & Determining Breeding Status:

The male wolf's testes regress in the spring and are quite reduced through the summer. The testes will begin to develop again in the late fall, as indicated by a distinct enlargement of the scrotum and a general loss of hair from the scrotal area. The breeding status of the female is generally not as easily detected. During the short period the female is in proestrus and estrus, depending on the individual, there may or may not be a detectable enlargement of the nipples and/or a detectable discharge including blood from the vulva area. It should be noted that vaginal discharge during pregnancy or around the time of parturition may be normal; however, discharge after the season or at any other time of the year may potentially indicate that the female has a uterine or bladder infection. As with other canids, uterine infections can be fatal but can be effectively treated if detected early. Most healthy female wolves will at least appear to undergo estrus during their first breeding season at about nine months of age. Although female wolves have successfully bred during their first "season" it is generally accepted that female wolves are not reproductively mature until their second season at approximately twenty-one months of age. Male captive-bred wolves have successfully bred during their second breeding season at approximately twenty-two months of age, and it is generally accepted that this is the age at which they first become reproductively viable. However, there is at least one published record of a generic gray yearling reproducing and the Mexican Wolf SSP© reproductive study has documented that a cross lineage Mexican

gray wolf at the Wild Canid Center produced viable semen at less than one year of age. Good record keeping, and backdating from prior whelping dates may aid the keeper in determining the period in which the animal is most likely to be in breeding status. Occasionally, determination of a female's breeding status can be aided by noting changes in the behavior of the male toward the female. Prior to copulation the male often becomes increasingly more interested in the female's urine and licking or sniffing her anogenital area.

Denning:

Mexican gray wolf females may excavate underground dens or make shallow depression dens or digs. In captivity it is important to offer them several options for denning; whether above or below ground, man-made structures or dirt mounds in which to dig. Facilities have successfully utilized:

- Man made, wooden den boxes
- Large mounds the wolves have excavated
- Underground den constructed of two sections of polyethylene pipe and a polyethylene manhole

The animal's seclusion should be respected by the keeper and such areas should be entered only in an emergency or for an occasional inspection. During whelping season, if a female disappears, attempt to establish her location from outside the enclosure. The alpha male's behavior may help locate her den site; he will generally spend a lot of time in close proximity to the den. If it appears that the female is denned up, all personnel access should be restricted. Human presence at this critical time could cause animal aggression towards the employee, den/pup abandonment, and/or infanticide with or without consumption.

Offspring:

Parent-raised offspring are preferred by this program. At times this approach to husbandry may be emotionally difficult for animal care staff that recognizes that they could do more to aid the survival of individual pups. However, one must continually bear in mind that the overall objective of the program is not to simply produce wolves but to produce wolves that can withstand the rigors of nature once reintroduced to the wild. Only in this way will the species be able to continue a natural existence. In the interest of reducing interference with "natural selection" and to avoid conflicts with the objective of producing "wild wolves", it is necessary to avoid hand-rearing or taking other extraordinary measures to increase survival rates unless such care is absolutely necessary for the survival of the species and approved by the USFWS Mexican Wolf Recovery Coordinator. (If you have approval for hand-rearing, guidelines can be found in Figure 9-B). Our concerns are that regularly taking such extreme measures may result in animals that are attuned to humans or result in the survival of undetected "substandard" animals that do not represent the wild species and would not survive once reintroduced to the wild. Although interference and handling is not recommended, the confinement of captivity tends to increase exposure of the animals to parasites and communicable

disease; therefore, some veterinary care of the very young is required to achieve litter survival rates that would be expected in the wild. The care involves treatments to reduce parasite infestations and inoculations to prevent disease.

Whenever possible, cross-fostering of pups would be preferred to pulling pups for hand-rearing. In cross-fostering, pups would be placed with those being cared for by a competent proven female at the same institution or another institution with a suitable match. Consultation with and approval from the USFWS Mexican Wolf Recovery Coordinator and MWSSP Coordinator are required as with hand-rearing.

Parental Care:

In general, adult Mexican gray wolves provide excellent parental care. Mexican gray wolves have successfully whelped in man-made dens or in a place of their own choosing such as a depression den or under a bush. Females may not allow the male access to the den when occupied by the pups. At approximately 4-6 weeks of age when the pups start venturing away from the den, the male and other pack members begin to take a more active role in their care by feeding, guarding, and socializing with the pups.

There is always concern that human handling of young animals may disturb their parents to the point that the young may be jeopardized. In most situations adults will provide for their litter even after required human intervention; however, afterwards they may move the pups to another location. Cautious, limited handling can occur under specialized circumstances. If this becomes necessary, care should be taken to limit the transfer of human scent to the pups by wearing surgical gloves, and not holding the pups up against your clothes/body.

Assisted Reproduction:

If small, isolated populations are to be managed genetically, basic assisted reproductive techniques such as artificial insemination (AI) can be an important substitute for translocating animals. Additionally, since wolves are monogamous and form long-term pair bonds in the wild, separating established pairs for genetic re-pairing can be stressful to the animals, which may impact reproductive success. Shipment itself has been shown to have negative effects on reproductive capacity in domestic species such as cows and sheep, and it might be expected to have even more extensive consequences in wild species. AI could be used to accomplish genetic pairings without the need for transfer.

Semen collection techniques for wolves are well-established, but handling and cryopreservation techniques require further development. Sperm survive freezing, but percentages are low and survival is short compared to other species. Semen has been banked for many male Mexican gray wolves, but post-thaw sample quality has not yet been verified by successful AI. Recent advances in semen cryopreservation methodology for domestic dogs should continue to be evaluated with wolf semen.

Until recently it was not possible to cryopreserve female gametes (oocytes), but advances with vitrification (freeze-drying) show promise for Mexican gray wolves. Although the techniques that will be required for the thawed oocytes to develop have not been completely successful, several labs around the world are concentrating solely on these procedures for application to domestic dog oocytes. Meanwhile, genes from individual genetically valuable Mexican gray females can be preserved in anticipation of future use.

Unfortunately, transfer of assisted reproduction techniques to canids, including domestic dogs, has proven more difficult than for most other species. Recent successes include induction of timed estrus and ovulation for AI in generic gray wolves and non-surgical AI in both generic gray and Mexican gray wolves (Asa et al. 2006). More advanced methods such as embryo transfer and in-vitro fertilization are likewise more difficult than in other species and require even more handling and manipulation than does AI, so are not yet practical for wolves. Fortunately, most applications of assisted reproduction in Mexican gray wolves can be accomplished with AI. For other methods to become part of recovery or management programs for wolves or other canids, considerable research and development are necessary.

Endocrine monitoring of hormonal changes associated with estrus and ovulation using fecal hormone assays can help diagnose reasons for reproductive failure. Similarly, fecal samples can be analyzed for cortisol as a possible indicator of stress. However, hormonal pregnancy diagnosis requires a blood sample for analysis of relaxin, the only hormone that distinguishes pregnancy from pseudopregnancy in canids. Behavioral observations can document courtship behaviors and determine whether copulation is complete, and video can monitor the den box during the period of expected whelping to establish whether pups are born (to distinguish pregnancy from pseudopregnancy) or if they are born live. (See Figure 4-E.)

References (Referencias):

L. David Mech. 1970. The Wolf: the Ecology and Behavior of an Endangered Species. The American Museum of Natural History. The Natural History Press, Garden City, NY.

Kent Newton. 1995. Mexican Wolf Husbandry Manual. Mexican Wolf SSP Management Group.

Will Waddell. 1998. Red Wolf Husbandry Manual Guidelines for Captive Management. Red Wolf SSP Management Group.

José F. Bernal and Jane M. Packard. 1997. Differences in Winter Activity, Courtship, and Social Behavior of Two Captive Family Groups of Mexican Wolves (*Canis lupus baileyi*). Zoo Biology 16:435-443.

C.S. Asa, K.L. Bauman, M. Callahan, J.E. Bauman, D.H. Volkmann and W. Jöchle. 2006. Induction of fertile estrus with either natural mating or artificial insemination followed by birth of pups in gray wolves (*Canis lupus*). Theriogenology 66:1778-1782.

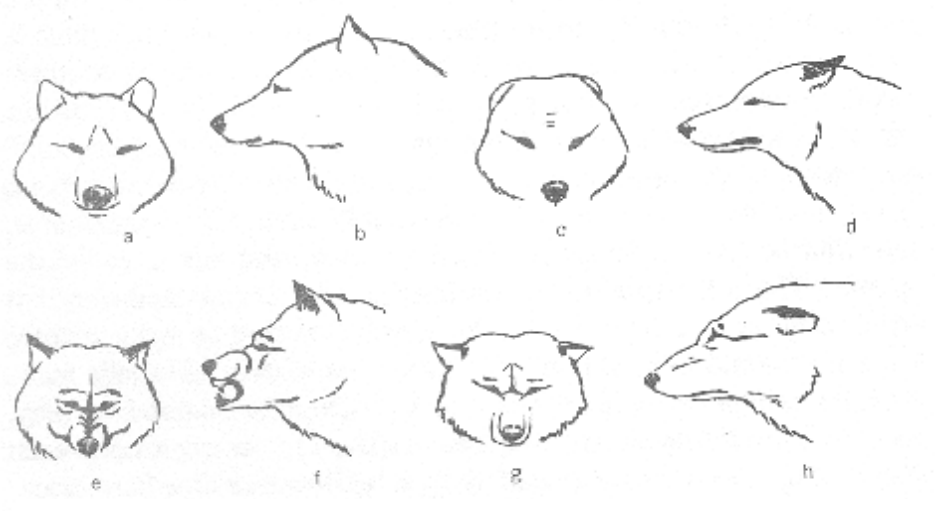


Figure 4-A
Facial expressions of the wolf: a and b, normal expressions of a high ranking animal; c and d, anxiety; e and f, threat; g and h, suspicion. (*From Schenkel, 1947*)

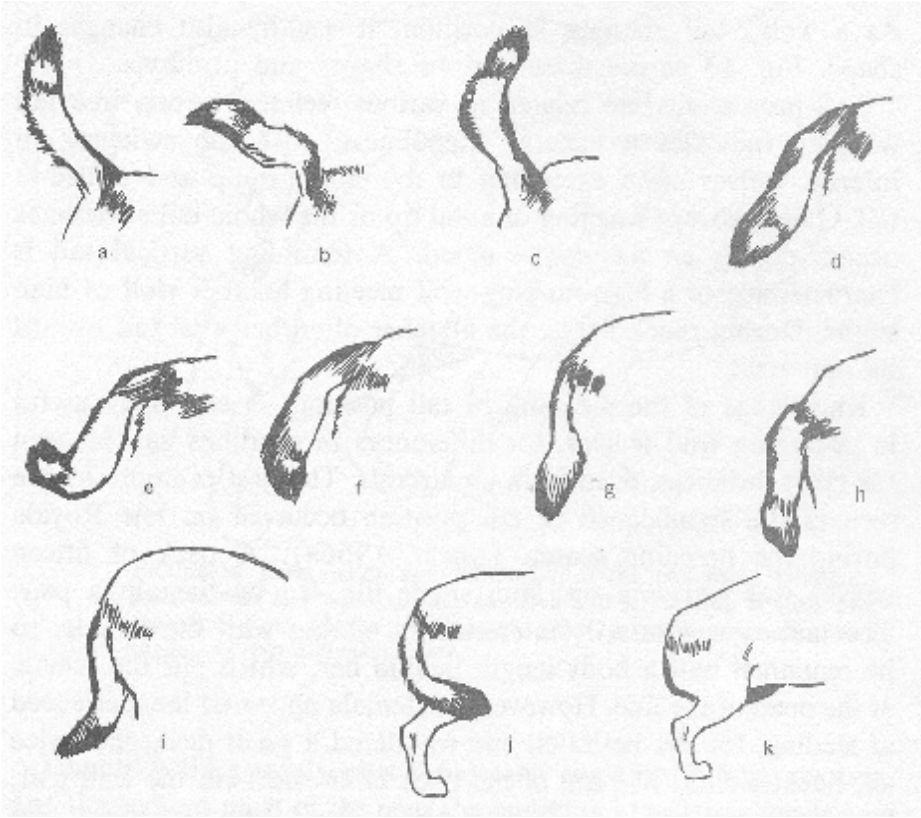


Figure 4-B
Expressive positions of the wolf's tail: (a) self confidence in social intercourse; (b) certain threat, (c) imposing attitude (with social pressure); (d) normal attitude (situation entirely without social pressure); (e) a not-entirely-certain threat; (f) normal attitude (similar to "d") particularly coming during eating and observing; (g) depressed mood; (h) between threat and defense; (i) ; (j) actively casting oneself down (with sideways brushing); (k) strong restraint. (*From Schenkel, 1947*)

All pictures taken from L. David Mech. 1970. The Wolf: the Ecology and Behavior of an Endangered Species. The American Museum of Natural History. The Natural History Press, Garden City, NY.

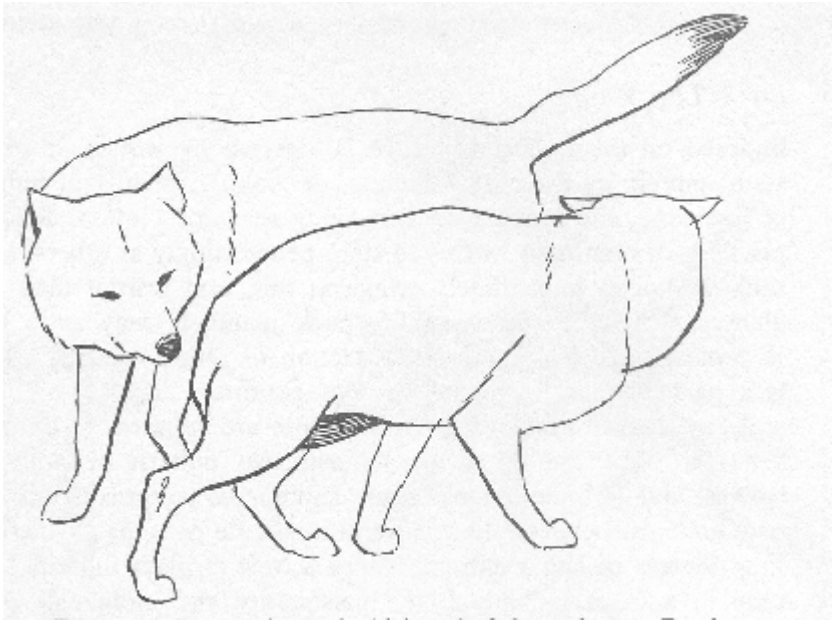


Figure 4-C
Presentation and withdrawal of the anal parts. Dominant wolf in rear is presenting his anal area and is exerting control over the anal parts of the subordinate, who is withdrawing his anal region. (*From Schenkel, 1947*)

Figure 4-D
A subordinate wolf usually shows "active submission" by holding its tail and head down when approaching a dominant animal. (*D.H. Pimlot*)

All pictures taken from L. David Mech. 1970. The Wolf: the Ecology and Behavior of an Endangered Species. The American Museum of Natural History. The Natural History Press, Garden City, NY.

Management Ethogram

General *Canis* behavior is well documented. It has been suggested by numerous researchers that closely-related canids (such as the *Canis* spp.) exhibit similar forms of behavior, though the frequency of the behaviors exhibited may differ significantly. This ethogram is not comprehensive; instead it is intended that captive managers use the following as a descriptive guide to Mexican gray wolf behavior to assist them in day-to-day management. The behaviors listed below are grouped by general category. It should be noted, however, that many of these behaviors may be observed in more than one context.

General Behavior

Approach	Wolf approaches another within 3 body lengths. An interaction is not required. Distinguished from threat by lack of an aggressive body posture or vocalizations.
Follow	Wolf follows another. They do not have to be within 3 body lengths, but actions must be simultaneous, i.e. both are locomoting, one behind the other.
Pass	Wolves locomote towards each other and pass (one going one direction, one the other) without stopping or interacting.

Elimination Behavior

Leg lift urination	Urination with one leg lifted off the ground.
Squat urination	Urination from a squatting position.
Over mark	Wolf urinating or defecating almost immediately over the urination or defecation of another.
Scent rolling	Rub of head, neck, back on a surface; often where another urinated or defecated. May include repeated full rolls in the area.
Defecate	Wolf discharges fecal material.
Scrape mark	Wolf uses both front paws and back to tear at the ground (dirt is usually thrown up in the process). May follow the discharge of urine.

Figure 4-E cont.

Social Behavior

Play	Interactive behavior event identified by play initiator (see below) performed by one wolf at some point in the interaction (most often at the beginning, but does not have to be). Play initiator can include any of the following: a) player bow-crouches on forelegs with elevated rear-end and straightened rear legs, b) exaggerated approach-gait is bouncy, or a rush; head and shoulders frequently moved side to side; c) approach/withdrawal can be at different speeds or showing physical intent to move away (e.g. rock back and forth); d) general movements such as head tosses, paw raises, etc. Play types include prone play, one up/one down play, wrestle play, locomotor play, and ambush/stalk play. Wolves can show any of the following: play "grin", head up and alert, tail wag, mouth open with lips drawn back and tongue out.
Unreciprocated play	Wolf directs any play type towards another, who subsequently does not respond, actively tries to avoid the initiator, or becomes aggressive towards it.
Self play	Wolf chasing its own tail, limb biting, etc.
Sniff or Lick A-G	Sniff or lick another's ano-genital area.
Present A-G	Female stands or walks with hindquarters oriented to male's face, back slightly arched, base of tail deflected up or to the side.
Attempted mount	Male attempts to mount female, though mount is unsuccessful (may be from incorrect orientation.)
Mount	Wolf standing behind another resting upon its back with forepaws clasped around the midsection/pelvic region; may be followed by pelvic thrusts.
Copulatory tie	Male and female are joined in a 'mount' position that lasts a minimum of 60 seconds. Seen after several short pelvic thrusts followed by 2 or 3 deep thrusts resulting in the tie. Back to back ties are sometimes seen.

Agonistic Behavior

Charge	Wolf locomotes rapidly towards another exhibiting one or more of the following behaviors: ears back, head down, hair is piloerect, forelegs are stiff. Recipient may either react (see fight, passive/active submission) or retreat.
Threat	Orientation towards another with threat facial expressions (vertical retraction of the lips and baring of the front teeth), stiff legs, ears forward and erect, elevated tail and hair piloerected. May be accompanied by a growl.
Chase	Wolf runs after another (both are running.)
Passive Submission	Wolf approaches another in crouch or semi-crouch position with body oriented sideways to partner; head typically rolled side ways while looking at partner. May be accompanied by whimper/whine and licking intentions towards partner.
Active Submission	In presence of another, wolf falls or lies on its side or back, often with hind legs raised and ears back. May be accompanied by whimper/whine. Can follow passive submission.
Fight	An interaction which is usually initiated by a charge from one individual, followed by both growling, rising up or partially up on their hind legs and batting at each other with the forepaws or grasping each other around the neck or shoulders (sparring), growling, threatening, and attempting to pin the other to the ground.

Vocalization

Whimper/whine	Soft whine, usually emitted while approaching another in a submissive (ears back, somewhat crouched) posture.
Aggressive vocalization	Growl, bark.
Distress	High pitched, whining or yelping vocalization. Often associated with submissive vocalization behavior.
Howl	A sustained vocalization in which the pitch can remain constant or vary smoothly between pitches.

Figure 4-F.

AZA WILDLIFE CONTRACEPTION CENTER
RECOMMENDATIONS FOR WOLVES

The progestin-based melengestrol acetate (MGA) implant, previously the most widely used contraceptive in zoos, has been associated with uterine and mammary pathology in large felids (Munson 1993), and these side effects are also likely to occur in other carnivores. Instead, the AZA Wildlife Contraception Center recommends GnRH agonists [e.g., Suprelorin® (deslorelin) implants, leuprolide acetate injectable implants, or Lupron®] as safer alternatives. However, dosages and duration of efficacy have not been well established for all species. The GnRH agonists can be used in either females or males, and side effects are generally those associated with gonadectomy, especially weight gain which should be managed through diet.

Following is general information on contraceptive options for Mexican wolves. More details and ordering information can be found at www.stlzoo.org/contraception.

Ovariohysterectomy: Ovariohysterectomy of females is the safest method for long-term control of reproduction for females that are eligible for permanent sterilization.

Vasectomy: Vasectomy of males will not prevent potential adverse effects to females that can result from prolonged, cyclic exposure to the endogenous estradiol and progesterone associated with the pseudo-pregnancy that follows all spontaneous ovulations in canids. This approach is not recommended.

Gonadotropin releasing hormone (GnRH) agonists [Suprelorin® (deslorelin) implants, leuprolide acetate injectable implants, or Lupron®]: GnRH agonists achieve contraception by reversibly suppressing the reproductive endocrine system, preventing production of pituitary (FSH and LH) and gonadal hormones (estradiol and progesterone in females and testosterone in males). The observed effects are similar to those following gonadectomy, but are reversible. They first stimulate the reproductive system, which can result in estrus and ovulation in females or temporary enhancement of testosterone and semen production in males. Then, down-regulation follows the initial stimulation. The stimulatory phase can be prevented in females by daily Ovaban administration for one week before and one week after implant placement.

GnRH agonists should not be used during pregnancy, since they may cause spontaneous abortion or prevent mammary development necessary for lactation. They may prevent initiation of lactation by inhibiting progesterone secretion, but effects on established lactation are less likely. New data from domestic cats have shown no effect on subsequent reproduction when treatment began before puberty.

Although they can also be an effective contraceptive in males, they are more commonly used in females, because monitoring efficacy in females by suppression of estrous behavior or gonadal steroids in feces is usually easier than ensuring continued absence of sperm in males, since most institutions cannot perform regular semen collections. Suprelorin® has been tested primarily in domestic dogs and cats, whereas leuprolide acetate and Lupron® have been used primarily in humans, but should be as effective as Suprelorin®, since the GnRH molecule is identical in all mammalian species.

If used in males, disappearance of sperm from the ejaculate following down-regulation of testosterone may take an additional 6 weeks, as with vasectomy. It should be easier to suppress the onset of spermatogenesis before the breeding season, but that process begins at least 2 months before the first typical appearance of sperm. Thus, treatment should be initiated at least 2 months before the anticipated onset of breeding.

Progestins: Melengestrol acetate (MGA) implants were previously the most commonly used method. Other synthetic progestins include Depo-Provera® (medroxyprogesterone acetate) injections and Ovaban® (megestrol acetate) pills. Although MGA has proven effective in canids, possible side effects include uterine and mammary disease, in addition to weight gain and symptoms of diabetes mellitus. Other progestins are also very likely to cause these same side effects, although data are not available for them all. Because estradiol seems to synergize with progestins to exacerbate deleterious effects on uterine and mammary tissue, progestin treatment should never be initiated during proestrus, a time when endogenous estradiol is elevated. In the gray wolf, proestrus (based on blood in vaginal smears) begins an average of 6 weeks before estrus. This means that for some individual females, estradiol may be elevated as much as 2 months or more prior to what is considered the beginning of the breeding season. The ideal time to begin progestin administration is during deep anestrus.

If progestins must be used, they should be administered for no more than 2 years and then discontinued to allow for a pregnancy. Discontinuing progestin contraception and allowing a non-pregnant cycle does not substitute for a pregnancy. In fact, non-fertile cycles are more likely to exacerbate deleterious effects, since both estradiol and progesterone are elevated during estrus, and ovulation is followed by hormonal pseudo-pregnancy with high progesterone. Use of progestins for more than a total of 4 years is not recommended. MGA implants last at least 2 years, and clearance of the hormone from the system occurs rapidly after implant removal. Progestins are considered safe to use during lactation.

Androgen: Mibolerone is a synthetic androgen in pill form that is approved for female dogs, but it may stimulate aggressive behavior, so is not recommended.

Vaccines: The porcine zona pellucida (PZP) vaccine may cause permanent sterility in canids after only one treatment, due to a cellular response causing depletion of oocytes. This approach is not recommended.

AZA CONTRACEPTIVE HEALTH SURVEILLANCE PROGRAM

Dr. Linda Munson conducts comprehensive pathologic examinations on reproductive tracts to detect deleterious effects associated with contraceptives. The results of these analyses become part of the AZA Contraceptive Advisory Group Pathology Database and provide important information about contraceptive safety that is used to make informed decisions for annually updated recommendations.

To conduct this study, complete reproductive tracts are needed from BOTH CONTRACEPTED AND NON-CONTRACEPTED females, so that it can be determined if diseases are spontaneous in a species or caused by the contraceptive. Reproductive tracts collected by ovariohysterectomy or at necropsy are appropriate. Pathology evaluations will be conducted free of charge and a report is sent to the contributing institution for the animal's medical records. For institutions with their own pathologist, please contact Linda concerning the sharing of tissues for this study.

INSTRUCTIONS FOR SUBMISSION OF TISSUE

Reproductive tracts can be fixed in buffered formalin by immersion of the entire tract for 72 hrs, if a small incision is made into the body of the uterus or each horn, making sure there is a ratio of 1 part tissue to 10 part formalin. If sending the entire tract is impractical, send a description (or photos) of necropsy results, samples of all lesions, 2 endometrial samples and both ovaries. A brief summary of the reproductive history of each animal should be included.

Send tracts and history to:

Linda Munson, DVM, PhD
Dept. VM-PMI, Haring Hall
School of Veterinary Medicine
University of California
Davis, CA 95616
PH: 916-754-7963
FX: 916-752-3349
EM: lmunson@ucdavis.edu

CHAPTER 5:
HOUSING AND ENCLOSURE REQUIREMENTS - DAILY MAINTENANCE

HOUSING AND ENCLOSURE REQUIREMENTS

Enclosure Size:

Mexican gray wolf enclosures should be as large as possible while still allowing for observation and management of the animals. Mexican gray wolves have shown considerable stress when housed in undersized areas as evidenced by pacing, aggression, nervousness, poor reproduction, and care of offspring. Some facilities have successfully bred and raised pups in smaller enclosures, and large size alone will not compensate for other factors such as topography and exhibit "furniture." However, all other factors being equal, it appears that larger enclosures are best. The following are the current housing standards within the Mexican gray wolf program:

- For a same sex or non-reproductive grouping – 4,000 ft^2 (371.6 m^2) enclosure plus two holding/shift areas of 150 ft^2 (13.94 m^2).
- For a single generation breeding enclosure – 10,000 ft^2 (929 m^2) enclosure plus two holding/shift areas of 150 ft^2 (13.94 m^2).
- For a multi-generational breeding enclosure – 10,000 ft^2 (929 m^2) enclosure plus an additional 4,000 ft^2 (371.6 m^2) enclosure, along with the two holding/shift areas of 150 ft^2 (13.94 m^2).
- For a potential release grouping – 20,000 ft^2 (1858 m^2) enclosure plus an additional 4,000 ft^2 (371.6 m^2) enclosure, along with the two holding/shift areas of 150 ft^2 (13.94 m^2).

Containment Barriers:

Mexican gray wolves are relatively easy to maintain, but can be hard on their enclosure through their daily travel patterns and propensity for digging. This may also be compounded by pens that are too small, especially as pups get older. Barriers may be constructed of a variety of materials. Metal bars, while sometimes used, are discouraged for aesthetic and safety reasons. If used, bars must be spaced closer than 2 in (5 cm) apart to prevent trapping limbs or wolf pup heads. This spacing also minimizes the likelihood of injury from biting on the bars. Using bars for new construction is discouraged. Wire fencing must be of sufficient strength to contain wolves; 9 gauge or heavier 2 in (5 cm) chainlink is recommended suspended on 2 in (5 cm) metal pipes that have been set in concrete. Vinyl coated wire is discouraged because wolves can easily chew off and possibly swallow pieces of the coating. Because some wolves are skillful climbers or jumpers, the vertical height must be at least 8 ft (2.5 m) with the addition of a 36 in (0.9 m) overhang extending into the enclosure at a 35-45 degree upward angle. To prevent digging all containment barriers must have an underground component. Mesh fencing 2-3 ft (0.6–0.9 m) wide extending horizontally into the enclosure 6-12 in (15.25

cm to 30 cm) below ground should be used to contain wolves. A concrete footing approximately 8-12 in (20-30 cm) wide can be poured at the gate to prevent digging at this area where a digging barrier can not be installed. All Mexican gray wolf enclosures must be inside a facility with a perimeter fence to serve as a secondary barrier to escape. Frequent fence inspection is recommended as one facility experienced a failure with 9 gauge fencing. Wolves are capable of snipping 9 gauge fencing with their carnassials; check for gaps or stretching at bar attachments and take extra precautions at any compromised fencing.

Unclimbable solid walls less than 11.55 ft (3.5 m) tall should also have an overhang as described for wire mesh containment. In more confined areas such as catch pens or small holding pens, overhangs may not be adequate to contain wolves and the entire top of the pen may need to be covered.

Glass, plexiglas, or Lexan barriers offer a pleasant unobstructed view of wolves to zoo or facility visitors. Care must be taken when introducing new wolves to enclosures with viewing windows, as wolves are likely to perceive them as open space and may be injured when jumping against them.

Cable mesh walls have been used in limited situations, such as viewing panels. It is very important that the cable be greater than 9 gauge with no openings greater than 2" x 2", and with absolutely no slippage at the cable crosses. Of equal importance is that the cable mesh be extremely taut. If it is even slightly loose it can trap the paw of a climbing wolf with disastrous results. In addition, if a determined wolf can slip its muzzle through the mesh, it will easily snip the cable strands with its carnassials. The support for a taut cable mesh viewing panel will require a very stout structure; the larger the cable gauge, the less stout the support needs to be to get the desired tautness. Cable mesh must also be checked regularly for strand breakage and be replaced if any is found. Digging and climbing barriers are still required with a cable mesh wall.

Wet moats may be used in Mexican gray wolf exhibits but should have an adequate barrier as described earlier to contain wolves. Steep slopes to wet moats must be avoided to prevent pups from falling in or becoming trapped in the water. If the water is two feet (.6 m) deep or greater, there must be no more than a 30° angle between the water and the adjacent substrate. Dry moats must be at least 18 ft. (6 m) wide to prevent wolves from jumping out. All moats should have a ledge that allows easy access out of the moat.

Enclosure Design:

Care should be taken in designing enclosures to avoid tight corners (less than 90 degrees). Wolves tend to climb or jump in corners and trap subordinates in these areas. A circular perimeter pen design may reduce stereotypic pacing and scattered running responses during capture procedures. For facilities with multiple pens, common fence lines must be avoided, when using 2 in (5 cm) mesh fencing. Past experience has taught us that both young and adult wolves can sustain serious injuries when an appendage is stuck through the fence housing another wolf. When the fence line is shared, a strong 9

gauge, 1 in (2.5 cm) chainlink mesh or comparable cable mesh must be used. An alternative is to create at least an 18 in (45 cm) buffer between the two pens. Similar precautions apply to any gaps between gates and gate hinges. Hot wire should not be used as a primary containment feature, but rather as a deterrent.

Shelter:

Shelters should be provided either on exhibit or in off-exhibit areas to allow the animals privacy, escape from inclement weather, or insects. Shelters can be either natural or man-made. Examples of appropriate shelters include: hollow logs, rock overhangs, underground dens, shade structures such as trees or bushes, holding buildings, or wooden man-made den boxes. For breeding pairs, at least two den or shelter structures should be available to the wolves at all times. This will give the female a choice for whelping and the male an alternate source of shelter if the female occupies one den box with a litter.

a) Den Boxes: Via a removable lid or back door, den boxes should readily afford keepers accessibility for cleaning, as well as, restraint or removal of wolves for routine examination and inoculation, or transfers. See Figure 5-A for guidelines and measurements of one version of a den box.

b) Natural Dens: Wolves will occasionally dig their own dens and may be encouraged to do so by providing the proper substrate in the enclosure. Although allowing wolves to dig natural dens is thought to encourage and strengthen "wild" behavior and skills, wolf-made dens can make the task of inspecting, removing, treating or monitoring adults and pups difficult and dangerous. There is also the possibility of the wolf-made den collapsing or creating other problems. The length, depth and location of the den and soil type should be considered when deciding whether to fill in the den or allow its continued use by the wolves.

c) Man-made Dens: The Columbus Zoo initiated the use of a new type of man-made, underground den built by Advanced Drainage Systems, Inc.®. The den is constructed of polyethylene, a material that is water proof, retains body warmth, and stands up to biting and chewing without breaking or cracking. It is composed of two sections of drainage pipe and a manhole with drainage holes drilled into the bottom. This structure was set on a gravel bed and buried by a large dirt mound, with the two pipes acting as entrances for the wolves into the den. A man door is installed into the back of the manhole/den area, which is built into the exterior of the enclosure or the side of the mound. When the tunnels are blocked off, this allows staff easy access to the interior of the den. The new dens have been well received by the breeding pair at Columbus and are being installed at other facilities. They allow the wolves the feeling and security of a natural underground den without the dangers of collapse or flooding posed by natural dens.

Substrate, Topography, and Furnishings:

The combination of substrate, topography, and furnishings can combine to increase the quality of the exhibit from the wolves' perspective. Mexican gray wolves should be

housed on a natural substrate such as grass, dirt, sand, or forest litter. Temporary holding or medical facilities may have cement or other hard surface flooring, but wolves should not be housed on these for long periods of time. Joint discomfort, especially in older animals, and excessive wear on nails and foot pads can result from prolonged housing on rough concrete. Natural substrates also allow and encourage natural behaviors such as caching bones and digging shallow depression resting dens. Enclosures should be furnished with deadfall, logs, or boulders and should be planted with trees and bushes to provide shelter and shade. "Furniture" should not be situated close to the perimeter barrier where animals could use it for climbing or jumping. If possible, varied topography such as terracing or earth berms should be provided. These features will allow wolves the opportunity to climb, hide, play, mark territory, and carry out other natural behaviors. A large and varied enclosure will minimize boredom and the associated stress and unnatural behaviors associated with confinement in low quality environments. Mexican gray wolves appear to enjoy access to water features. However, safety precaution described above for wet moats should be applied to all water features.

Temperature and Humidity Requirements:

Mexican gray wolves have been kept successfully from Michigan to Texas in the United States without environmental heating or cooling, but radiant or forced air heat and air conditioning, mist systems, or swamp coolers may be used in extreme weather or for ill individuals at the discretion of the facility.

Support Space:

Multi-purpose off-exhibit holding, shifting, and isolation areas for capture or quarantine can enhance management capabilities. These areas should be easily accessible from the main enclosure, and wolves should be made familiar with them through feeding and or continuous access. Shift areas should be accessible to the wolves at times other than capture or stressful procedures so they do not become reluctant to use them. Buildings are less desirable than shift areas since some wolves are very reluctant to enter them and releasable animals should not be attracted to buildings. If a holding building must be used, it should be well lit and ventilated, easily sanitized, and have remotely operated doors for shifting wolves.

DAILY MAINTENANCE

Daily Log Book:

Written daily reports should be maintained by the animal keepers indicating at the minimum the wolves' general condition, food consumption, and animal interactions. Additional information may be kept such as food supplements, enrichment, the animal's bowel habits, weather conditions for that day or maintenance/repairs of the enclosures (see Figure 5-B for a daily record sheet example).

Enclosure Cleaning and Maintenance:

Good sanitation including daily removal of feces, old bones and uneaten meat from wolf enclosures greatly reduces the incidence of intestinal parasites and disease in wolves. Prompt removal also eliminates the attraction of insects such as biting flies or other pests to the enclosure area (see Figures 5-C, 5-D, 5-E, 5-F, 5-G, 5-H and Chapter 8 for additional pest control information). However, daily removal must be evaluated in each facility and weighed against the stress level it may cause the occupants. In addition, proper foot wear and disinfecting procedures when moving between enclosures is also imperative for reducing the incidence and spread of intestinal parasites and disease. For keeper safety it is always a sound management practice to have more than one person accessing an enclosure at a time. When moving about inside an enclosure for feeding or cleaning, keepers should remain together throughout the enclosure moving in a circular route. This allows the wolves to avoid the keepers and at the same time keep the greatest amount of distance away. Keepers cutting through the center of an enclosure or failing to remain together separate animals thereby causing confusion and increased levels of stress, as well as, compromising their safety. Repeatedly using the same circular pattern should reduce the wolves stress level as they learn to recognize the feeding and cleaning routine.

General Feeding Practices:

The Mexican Wolf SSP© recommends feeding a high quality, meat-based dry dog food as the basic diet for captive Mexican wolves. Supplemental feed items such as prepared meats, bones and carcasses may also be fed, but should not be given in high enough quantities as to interfere with the balanced composition of the principal diet.

Adult Mexican gray wolves can meet their maintenance requirements by feeding once a day. Pairs or groups need not be separated for feeding, but enough separate feeding stations should be provided to insure that the dominant animals can not monopolize all feed. Many facilities feed their wolves in shift or holding areas which has the advantage of providing privacy and of conditioning animals to use these areas. Care must be taken to insure that conditioning the animals to an area does not include conditioning or acclimating them to humans. As mentioned earlier, it is strongly suggested that potential release candidates be fed through remote feeding. Feed - give access - then leave.

Feeding times vary among Mexican wolf facilities. Some facilities feed at the end of the day since wolves may be reluctant to approach a feeding area when personnel are present, the wolves are more active late in the day, or to avoid exposing food for long periods to environmental factors, animal vectors (birds, ants, etc.), or spoilage. Other facilities that feed an all dry diet and don't have to worry about spoilage have a morning feeding routine in order to observe feeding problems such as aggression over food. In addition, there are a number of accepted food containers or structures in which the food can be presented. Many facilities feed from stainless steel bowls, others place the food directly on an open surface such as a concrete pad, while still others utilize feeding trays that are elevated off the ground and provide cover to keep the food dry from the outdoor

elements. Whichever method works best it is important that proper disinfection and cleanliness of the food bowls or feeding areas is maintained.

Carcass Feeding Guidelines:

Whole or partial carcasses are often fed to captive Mexican gray wolves, mainly for behavioral enrichment reasons (additional enrichment recommendations can be found in Figure 5-I). Facilities have reported feeding the following: rabbit (brown, white, wild), chicken, turkey, pheasant, rats, mice, pig, javalina, white-tailed and mule deer, cattle, goat, sheep, elk, horse and donkey. Carcasses from animals of known health status are preferable to those from animals of unknown health history (e.g. road kill) to reduce possible exposure to endoparasites and other pathogens. If carcasses from animals of unknown history are fed, they should be inspected for signs of communicable disease and for freshness. In recent years chronic wasting disease has become a concern. If you are feeding carcass from an area in which the deer population is known to be affected by this disease, it is strongly recommended that the brain stem and spinal chord be removed or that only the meat from the carcass be fed. As with any feed item, carcasses should be stored and handled in a manner designed to minimize spoilage or contamination.

A distinction must be made between acceptable carcass feeding practices for wolves that will never be released to the wild and potential release candidates. Wolves which may be released to the wild must not be fed carcasses of domestic animals, as this may lead to wolf/livestock (and livestock owner) conflicts after release. Prenatal chemosensory learning has been demonstrated in the domestic dog as well; the mother's diet affected the chemosensory preferences of neonatal pups (Wells and Hepper, 2006). With this distinct possibility in play with wolves raised for release, caution should be exercised with the diet choices offered to pregnant females as well. If possible, carcasses from prey species that will be found in release areas should be fed to release candidates. Wolves which will never be released to the wild may be fed other carcasses.

Perimeter Checks and Safety Inspections:

Fence integrity is imperative to the safety of all the animals in an enclosure. Maintenance checks and fence and perimeter inspections should be part of a keeper's daily routine. Fence lines must be inspected daily to detect any need for repairs, sharp protrusions, and to fill any substantial holes which might provide opportunities for escapes or injuries.

References (Referencias):

Kent Newton. 1995. Mexican Wolf Husbandry Manual. Mexican Wolf SSP Management Group.

Will Waddell. 1998. Red Wolf Husbandry Manual Guidelines for Captive Management. Red Wolf SSP Management Group.

Deborah L. Wells and Meter G. Hepper. 2006. Prenatal olfactory learning in the domestic dog. Animal Behaviour. 72: 681-686.

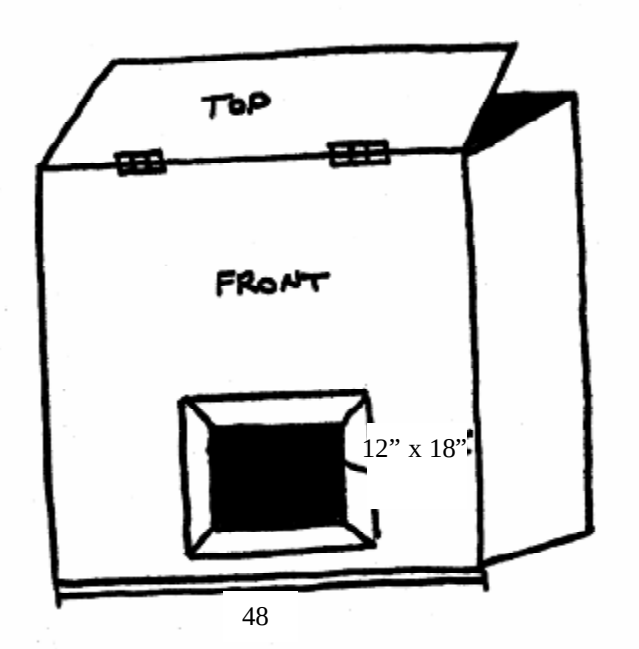


Figure 5-A Typical den box design.

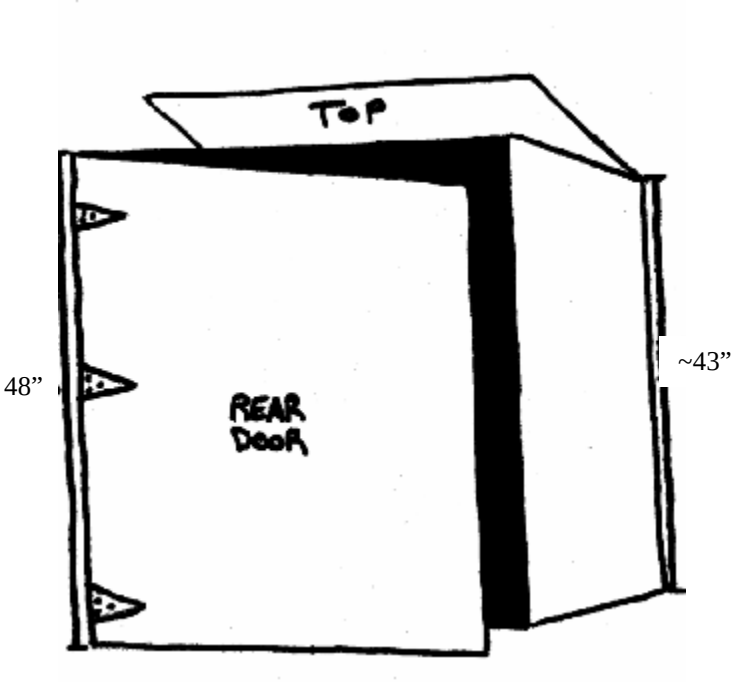


Figure 5-B

DAILY LOG
WILD CANID SURVIVAL AND RESEARCH CENTER

Personnel:_____ Weather:_____
Perimeter Check: WED_____ Date:_____
Observations:_____
_____
_____

ENCLOSURE	STUD BOOK #'S	CENSUS	OBSVD	LEFT	GIVEN	ENHANCEMENT	P/U SCAT	RATING
A	105, 204	2	2	0	4			
B-1	619, 621	2	2	1	3			
B-2	2010, 2158	2	2	345g ♂ 224g ♀	700g ♂ 700g ♀	rats	X	B
C-1/2	520, 547, 817,818, 819,820,821	7	7	3	11			
D/E	536,685,804,805, 806,807,808,809, 810,811	10	10	5	10			
F-1	572	1	1	1	1			
F-2	606	1	1	½	1 ½			
F-3	658	1	1	0	2			
ISO	740	1	1	0	1030g DC	Clindamycin, Clavamox	X	A
G-1	2203, 2204, 2205,2208, 2214	5	5	2	2.5lb DC 2lb MZ			
G-2	192, 546	2	2	3	1			
R-1	819, 1120	2	2	0	4			
R-2	66, 109, 681	3	3	2	4	#66 Rimadyl		
S-1	1441, 1442, 20001, 20002	4	4	2 c	4 c	mice		

Rating Code: A= well formed B= poorly formed C= pile, no form D= semi-solid E= pool of H2O

Work accomplished: _____
_____
_____
_____

FEED: Delivered # Box # Igloo Distributed
_____ _____ _____ _____

Reviewed:_____

Figure 5-C

A Report On Stable Fly Problems

By Ken Kawata/Belle Isle Zoo Curator
For the Mexican Wolf Captive
Management Committee
June 1992

1. INTRODUCTION

During the Mexican Wolf Captive Management Committee meeting in August 1991, problems of stable flies, Stomoxys calcitrans, were brought up. The problem mainly stems from flies attacking wolf ears. It was decided that I assemble a packet of information for all committee members, so that each facility may develop a comprehensive approach to fly problem. What follows is a brief summary of the information from written comments from member institutions and my personal observations.

2. RANDOMNESS OF THE PROBLEM

A. Absence of fly attacks

One institution replied, "…we have not (to my knowledge) had any stable fly problems." Another institution wrote, "…we have had minimal damage done by fly strike."

B. Individuality

It appears that stable flies do not uniformly strike all wolves in the group. One institution wrote, "the flies only attack to a great degree two or three wolves a year." Another institution pointed up, "…we have had certain individual wolves in certain situations have a fly bite problem. None of our wolves currently have a problem."

3. WORKABLE SOLUTIONS

Approaches to the fly problems usually take two directions: environmental and direct treatment. Some comments from member institutions and my observations:

A. Wild Canid Research and Survival Center (Vicki O'Toole)

"…we pick up scats and dispose of them every other day. Our primary spray program is aimed at preventing ticks from taking hold, but we do spray with some pyrethrin based products."

B. Alameda Park Zoo (Steve Diehl; this institution has not experienced serious problems)

"By removing fecal and other organic materials from the exhibit area quickly, we have been able to keep the fly population somewhat under control."

C. Phoenix Zoo (Reg Hoyt and my personal observations)

A water-based 0.15% pyrethins, manufactured by Vet Kem (Flea & Tick Pump spray), has been used for environmental application (one other zoo sprays over grass and shrubs in the enclosure with hose). A 2' X 2' piece of burlap, hung on the chain link fence, may be sprayed daily by keepers; this method proved efficient, as wolves rub against the chemical-saturated burlap. (However, depending on the individual, wolves may shred it to pieces). Another application is to use a garden spray with copper tubing, permanently installed by the holding area, where feed and water are placed. The mist head is directed over the entry, and wolves must enter the holding area to eat and drink daily through the mist of solutions. Every morning keepers pump in, build the pressure up and open the valve. According to Reg Hoyt, an electrically operated spray system is now commercially available (West Livestock Service 602-982-2509).

D. Belle Isle Zoo (My own observations)

Of the four wolves we have held, one animal (Studbook #41) has been damaged severely. Flies have annoyed the other three animals but did not traumatize them. During the summer, the ears of #41 were literally eaten by the flies. Several control methods were devised, with varying degrees of success, by the staff veterinarian, Dalen Agnew as follows:

a. Environmental

Dr. Agnew invited several entomologists from Michigan State University to review the problem. One of their recommendations was to change the zoo's manure handling, in order to eliminate breeding ground of the flies. This meant that no animal waste and soiled bedding were to be exposed in the "manure bay" for later pickup; rather, they were to be contained in plastic bags and in garbage cans and picked up semi-weekly. By this approach, stable flies would be less able to breed on the zoo premises.

Another approach was fly traps. One is called "Sticky Fly Traps" (manufactured by Olson Products, PO Box 1043, Medina, OH 44258, 216-723-3210). A glued surface, when placed in the sun, is expected to specifically attract stable flies. The trap is easily assembled and not costly. It, however, requires direct sunlight exposure and a specific height off the ground to be maximally effective – neither of which could be accommodated due to the exhibit design. Thus, it achieved a limited success in Detroit. Another non-electrical fly trap, called "Big Stinky", placed around the perimeter of the exhibit, captured a large number of house flies, but few stable flies. As for electrically operated fly traps, one zoo commented that "fly zappers", manufactured by Gardner Manufacturing (P.O. Box 147, Horicon, WI 53032, 800-558-8890)

attract stable flies. However, Belle Isle Zoo has not yet used this product. We have also used permethrin on the premises semi-weekly to little avail. Mowing grass and trimming shrubs in the enclosure may have helped.

b. Direct Applications

Keepers tried to spray the wolves with Vet Kem products (Pyrethrins, Piperonyl & Resmethrin) and reported a positive impact. However, wolves eventually stayed away when they found out that keepers had spray bottles, this method may work on "tame" individuals. Another approach was to apply pyrethroid fly repellent gel into the body surface whenever animals were immobilized. To date, the most effective method at Belle Isle Zoo has been the use of Fenvalerate insecticide impregnated eartags. While other controls proved inadequate or unsatisfactory, the eartags keep flies away from the ears. This may not be effective where breeding pairs are maintained, since mates may not leave them alone. However, at Belle Isle Zoo, where a "uni-sex" group is maintained, and no intimate relationships develop between group members, this approach has been highly preferable. In the summer of 1991, Dr. Agnew discussed the use of Ectrin Insecticide Impregnated Ear Tags on the wolves with the National Poison Control Center at the University of Illinois, College of Veterinary Medicine and the manufacturer, Fermenta. It appeared it would be safe to use this product on the Mexican wolf. According to the National Poison Control Center, the LD50 of Fenvalerate (the active ingredient) is 450 mg/kg. Using a recorded wolf weight of 20 kg, we would have an exposure of 40 mg/kg, ten folds below the LD50 value. Further, considering that (1) only one-eighth to a quarter of a tag will be used, (2) the Fenvalerate is in a slow-release formulation, and (3) the low probability that the animals will get close enough to each other to ingest the tag, it seemed unlikely that a toxicity problem would occur. They were fed 0.076 g/kg of Fenvalerate per day for several months with no ill effects. Should the tag be used, there would be no more than 0.04g of fenvalerate available for ingestion over one day. Based on the above, eartags were applied. Since the tags were designed for livestock, they were reduced in size for wolves' ears. For exhibit purposes, more "naturalistic" colors, such as brown and dark tan were chosen as opposed to bright red or blue. A regular eartag applicator was utilized. Even after the eartags were attached, stable flies still followed wolves and continued to annoy them. Yet, we saw no open wounds that would present not only an animal welfare issue, but also a serious public relations problem.

4. References

Integrated Pest Management of Nuisance and Biting Flies in a Michigan Resort: Dealing with Secondary Pest Outbreaks. Richard W. Merritt, M. Keith Kenneday, and Edward F. Gersabeck. In: Urban Entomology: Interdisciplinary perspectives. G. W. Frankie and C. S. Koehler (eds.), pages 277-299, Praeger Scien., NY. 1983

After this survey was conducted, the Minnesota Zoo (Nick Reindl) has had success using Defend Exspot (manufactured by Pitman-Moore 1-800-842-3532).

Figure 5-D

TABLE 2 from RWSSP Husbandry Manual: Control methods used for fleas and ticks.

Institution	Product Name	Manufacturer	Method/Freq. of Application	Results	Comments
Alligator River	Fly Trap	Sterling IPC	Hang trap in area of fly source/replace every 3-4 months	Excellent	Simple, very effective
Beardsley Zoo	Repel-X		Mix to proper dilution & mix with bedding or mulch/daily	Good	Helps but doesn't solve problem
	Ectrin Cattle Tags	Fermata Animal Health	Place in ear and cut to ¼ size/seasonally	Poor	Hard to keep tags in
	Solar Fly Traps	Arbico	Set baited traps in problem areas.	Good	Need to be maintained
	Revap E.C.	Fermata Animal Health	Mix to proper dilution & spray non-animal areas/weekly	Poor	May work better if applied more often
Brevard Zoo	Bronco-equine fly spray	Farnam	Impregnated fire hose strips placed in mouth of night house/spray strips biweekly	?	Method just instituted
Brunet Park Zoo	Fly wipe	Various	Sprayed directly on animal/daily	Poor	Could not get close; worried about eyes; worked well on Arctic wolves
	Garlic		1 clove/diet/day	Fair (?)	
Chaffee Zoo	Crushed garlic		In diet daily	Good	Worked on gray wolves, not needed on reds
Fossil Rim	Permectin II		Direct spray on animals as opportunity arises		
			Direct spray on grass & in houses/monthly	Good	
Great Plains Zoo	VIP Fly Repellent Oint.	Pet Chemicals	Smeared on ground & wolves roll bodies in it (use on alternate days with Tick Killer)	Fair (?)	Some wolves roll more than others; have to use a lot
	Adam's Tick Killer	Smith-Kline-Beekham	Smeared on ground & wolves roll bodies in it	No change	Can spray timber wolf when he walks up to fence, not red wolves
	Defend exspot	Pitman-Moore	1cc between shoulder blades, 1cc at base of tail & a couple drops on each ear/monthly		Method just implemented
Miller Park Zoo	Defend		1cc tube-1/2 dribbled on each ear; other 1cc tube dribbled down middle of back/bi-weekly	No change	Just went from monthly to bi-weekly application
	Trap-N-Toss fly traps		Hang 3-5 around perimeter of 150'x150' exhibit/replace when full-usually 1-2 weeks	?	Traps catch lots of flies
	Golden Malrin Fly Bait		Hung in refillable dispersers on exterior of exhibit/refilled every 4-6 weeks	?	Use quite a bit of product
	Fly Parasite	Beneficial Insectary	Parasitic pupai spread around exhibit/weekly from spring till fall in 1995	?	
Pittsburgh Zoo	Swat		Applied directly to ears/when animal is down	Good	Too few opportunities to apply
	Fly spray		Sprayed around head avoiding eyes/daily		Difficult to apply Short duration of protect.

Point Defiance Zoo	Schreiners Healing Liniment	Restoration Products	Applied by hand to both ears & top of head/twice a day	Excellent	Used in severe cases only
	Rescue disposable fly traps	Sterling International	Hang around perimeter fence & in between pens/change as needed.	Excellent	Still see an animal with a problem
Racine Zoo	Insectin X	Hess & Clark Inc.	Sprayed directly on animals from pump sprayer/when flies are covering ears	Good	
	Permectrin Dust	Anchor	Sprinkled in wooden shelters & on ground where animals lay/weekly	Good	Also added to straw that is given as enrichment
	Permethrin LPS	Dionne	40cc/gal water-spray outside perimeter in tall grass & bushes/twice week (repeat after rain)	Fair	
	Vectro System Fly Zapper	Micro-gen	electrical bug zapper in keeper area of building/sticky board replaced as needed	Excellent	Building is free of flies
	Fly Terminator	Farnam	Placed on ground around perimeter fence-baited per directions + one dead fish/change as necessary	Good	
Trevor Zoo	Fly Pest Strips		Hang in key areas of zoo/changed monthly		
Wild Canid Center	Permethrin spray	Various	Fine mist sprayed around facility perimeter/weekly	Excellent	County Health Dept. applies
	Permethrin spray	Various	Sprayed on ground in certain areas of enclosures to initiate scent rolling/as needed	Fair	Wolves stop rolling when they get used to scent

Figure 5-E

TABLE 3 from RWSSP Husbandry Manual: Control methods used for fleas and ticks.

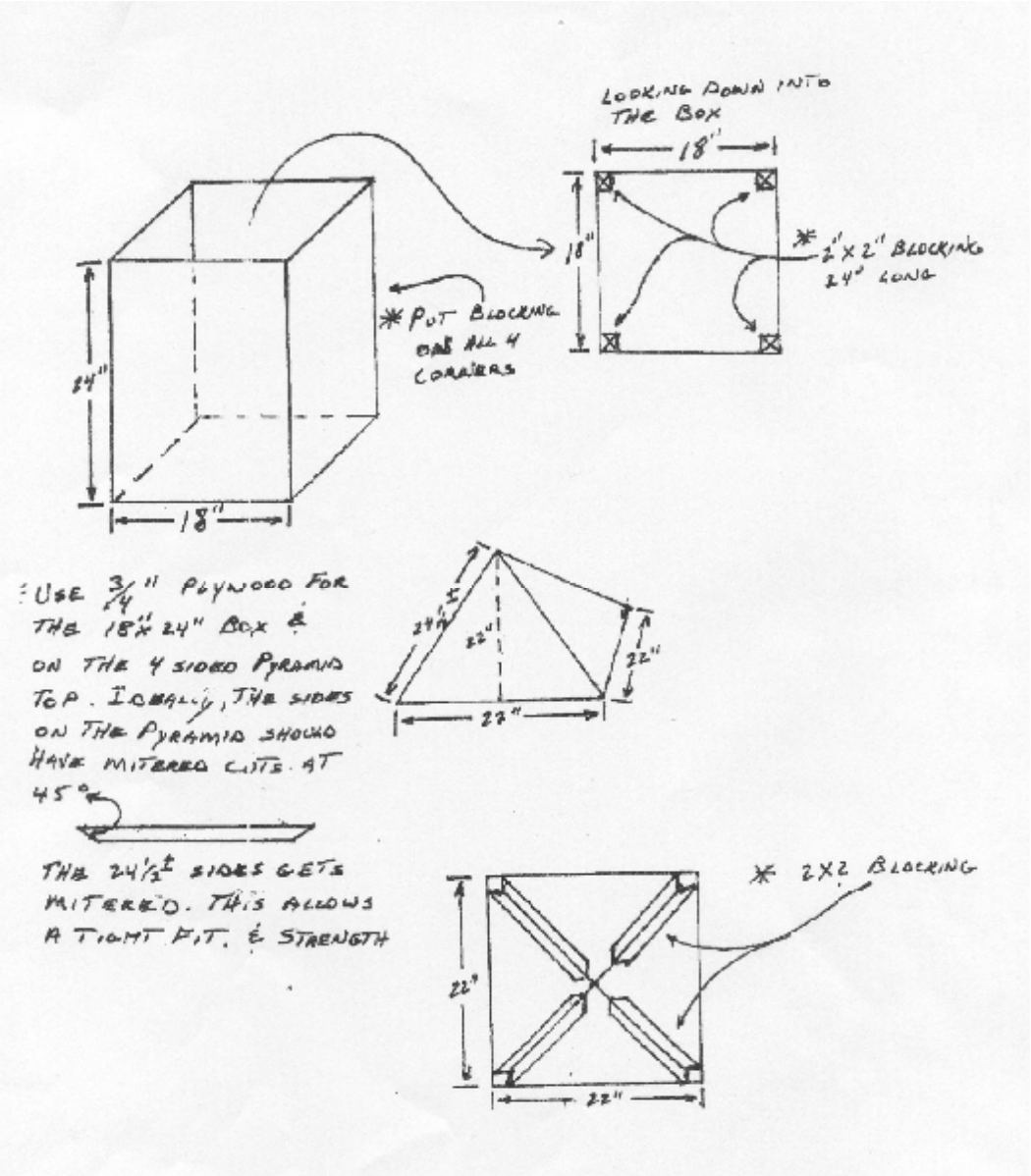
Product Name	**Method/Freq. Of Application**	**Results**	**Institution**	**Commments**
Yard and Kennel Spray; Vet-Kem	Sprayed in pens with hose end sprayer/as needed	Excellent	Alligator River	
Spot-ON; Miles, Inc.	Applied directly to backline at .8cc per 10lbs/as needed	Excellent	Alligator River	Used for severe cases
Program (Luferuron); Ciba-Geigy	Oral during feeding/monthly year round Orally during feeding/monthly Orally during feeding/monthly during flea season Orally during feeding/monthly	Excellent Prevention Excellent Good	Chaffee Zoo North Carolina Zoo Racine Zoo The Texas Zoo	 Discontinued – could not separate easily
Basis; Ciba-Geigy	Sprayed yard at beginning of flea season	Excellent	Chaffee Zoo	No longer needed
Ivomectin	Orally in food – 1ml per 110lbs/one time dose	Fair (?)	Fossil Rim	Used for severe cases
Ovitrol Plus; Vet Kem	Wrapped pups in lightly sprayed towels/when pups are handled for other reasons	Fair	Mill Mountain Zoo	No skin irritation seen
Permethrin Spray	Sprayed from high powered hose into ground to penetrate ground & leaf litter around perimeter of enclosures/beginning & end of season	Excellent	Wild Canid	County Health Dept. applies

Figure 5-F

TABLE 4 from RWSSP Husbandry Manual: Exhibit/management modifications used to reduce the problems with insects.

Modification	**Comments**	**Institution**
Keep grass between exhibits down.		Beardsley Zoo
No standing water. Exhibit mowed once a week.	 Cuts down on insect densities.	Brevard Zoo
Drain standing water		Burnet Park Zoo
Natural dens and low vegetation		Chaffee Zoo
Keep vegetation low.		Great Plains Zoo
Minimal vegetation, dens partially below ground & disinfected regularly, allow shallow holes to be dug.		Knoxville Zoo
Mow area when too tall, no standing water, added more shelters		Miller Park Zoo
Minimal vegetation, allow holes to be dug.		Mill Mountain Zoo
Drain standing water by filling in holes in yard.		Pittsburgh Zoo
Occasionally trim vegetation		The Wilds
Natural dens		Trevor Zoo
Keep vegetation mowed. Do not allow leaf litter to accumulate Remove standing water. Keep compost heaps & garbage containers covered.	Extremely helpful in tick control. Eliminated tick cover. Extremely helpful in fly control.	Wild Canid

Figure 5-G Smithsonian National Zoo stable fly trap design.



REQUEST FOR INFORMATION ON ALTERNATIVE FLY, FLEA, AND TICK CONTROL METHODS

If your facility has had success controlling flies, fleas, or ticks with any methods not listed in the following tables, please fill out the following form and mail or fax to Dr. Linda Munson, Mexican Wolf SSP© Pathology Advisor, Department VM-PMI Haring Hall, School of Veterinary Medicine, University of California, Davis, CA 95616; PH: 530-754-7963; FX: 530-752-3349, EM: lmunson@ucdavis.edu .
Please also send a duplicate copy to Peter Siminski, Mexican Wolf SSP© Coordinator, The Living Desert, 47-900 Portola Avenue, Palm Desert, CA 92260-6156; PH: 760-346-5694, ext. 2103; FX: 760-568-9685; Email: psiminski@livingdesert.org

Institution:_____

Product Name:_____

Manufacturer:_____

Method and Frequency of Application:_____

_____

_____

_____

_____

Results:_____

_____

Comments:_____

_____

_____

_____

Form completed by:_____

Address: _____

_____

Phone number:_____

Email address:_____

Environmental Enrichment for Mexican Gray Wolves
(original dated 2000 with item updates through 2006 MWSSP meetings)

Jose Francisco Bernal Stoopen MVZ	President of Mexican Wolf Technical Advisory Committee
Susan Lyndaker Lindsey PhD	MWSSP Management Group Member, Ad-hoc Behavioral Advisor to USFWS
D. Peter Siminski	MWSSP Species Coordinator
Colleen Buchanan	U.S. Fish and Wildlife Service

At the April 2000 AZA Regional, the above people met to consider enrichment in Mexican gray wolves. As part of the Mexican Wolf SSP Keeper Training Workshops, it was determined that facilities in both the United States and Mexico were interested in pursuing enrichment for this species. Dr. Stoopen performed a literature search to amass a comprehensive list of enrichment items used for gray wolves.

Participants in the Mexican Wolf SSP Program are all well aware of our ultimate goal which is to rear releasable wolves for reintroduction programs in the United States and Mexico. Zoological institutions are also well aware of the importance of enrichment in enhancing the lives of captive animals. Believing that enrichment would also enhance the repertoire of natural behaviors which captive wolves display (i.e. scent marking, predation, denning, etc.) and possibly increase the likelihood that a particular wolf makes a smooth transition to a wild life, we have attempted to present here a list of preferred/approved enrichment items for Mexican gray wolves. At any point in time it is difficult to predict whether or not a particular wolf is a potential release candidate – needs change for the program – and with this in mind we have chosen not to create separate lists (one for releasable wolves and one for those not destined for release).

Institutions are encouraged to present as many of the items on this list as are feasible for their situation. From a MWSSP or USFWS perspective, enrichment is not a requirement but it is highly encouraged. At each annual meeting institutions may request additional items be included; the list will be updated annually accordingly.

Feeding Enrichment

Presentation:

Vary feeding regime (feast/famine)
Vary time food given each day
Diet spread over the course of day
Buried food
Present food items when wolves cannot see them being placed/hidden, if possible
Hide food items in enclosure
Novel food items in pond
Several feed pans/stations
Hang food items from trees/branches
Frozen food items

Specific Items:

Mealworms	Crickets	Ice cubes with meat
Pinkies	Canine meat	Blackberries
Ice blocks	Dog chow	Melons
Cherries	Antlers	Trout
Blueberries	Pumpkins	Orange
Snow	Smelt	Rawhide bones

Hair from game native to release area
Bones from game native to release area
Live prey, game native to release area (e.g., brown rabbit, turkey, quail)
Dead meat from game native to release area (e.g., deer, elk, rabbit, turkey, quail, beaver, pronghorn, javelina, rodents, ground squirrels, vole, prairie dogs, pinkies, rats)

Olfactory Enrichment

Note: Be aware that there are possible medical risks associated with presentation of urine and feces (bison brucellosis, etc.)

Urine (autoclaved) of:	Feces (free of parasites) of:
Wolves	Wolves
Coyotes	Coyotes
Foxes	Foxes
Black bears	Black bears
Cougars/pumas	Cougar/pumas
White-tailed deer	White-tailed deer
Mule deer	Mule deer
Lagomorphs	Lagomorphs

Scents:

Note: No perfumes or aftershaves should be used

Vinegar	Orange
Chamomile	Mint
Vanilla	Lemon
Peppermint	Almond
Anise	Cinnamon
Pecan	Banana
Strawberry	Maple
Honey	

Spices:

Allspices	Onion
Chives	Paprika
Cinnamon	Sage
Cumin	Ground cloves
Coriander	Rosemary

Figure 5-I cont.

Environmental Enrichment:

Note: No Christmas trees (concerns about disease transmission from household pets).

Plant/grasses in several areas	Straw
Substrate piles/dirt and brush piles	Dry grasses
Grass patches for "hiding"	Sand
Logs with holes drilled for food items	White pine
Furniture rearrangement	Hiding places
Burrows	Bark mulch
Dead leaves	Pine shavings
Pine cones	Pine needles

Auditory Enrichment

Any naturally occurring sound (animals found at release sites)
No radios (could attract them to humans)
Sirens OK

Additions from 2001-2006 MWSSP Meetings:

Feeding Enrichment: superworms, rats
Olfactory Enrichment, scents: almond
Environmental Enrichment: bedding, logs, sticks from exhibits housing specimens that would be game or predators native to release area; logs with holes drilled for food items

CHAPTER 6:
IDENTIFICATION AND RECORDS

Identification Methods:

Properly marking individual animals for identification is an important function in the management and husbandry of captive animals.

a) Tattoos: Early in the program all Mexican gray wolves were tattooed with an institutional number inside the pinna of each ear and inside the upper thigh. A number of tattoo methods have been tried. The most distinct and long-lasting marks can be made by an electric tattoo kit. However, today it is recommended that all Mexican gray wolves be identified with a microchip transponder instead of a tattoo mark.

b) Transponders: Until the August 1999 SSP© meeting, it was recommended that all Mexican gray wolves be implanted with a Trovan Transponder. The Trovan System is the global standard recommended by the International Union for Conservation of Nature and Natural Resources and Captive Breeding Specialists Group (IUCN/CBSG) working group on permanent animal identification. However, InfoPet, the company that distributes the Trovan System has been involved in ongoing litigation with Avid, a company that produces a microchip system widely used in the pet industry. The end result is that Trovan transponders have been difficult, if not impossible, to procure in the last few years. The Mexican Wolf SSP© Management Group is now recommending that cooperators make use of a system that can read a wide variety of transponders, such as the Destron System marketed by BioMark (134 N. Cloverdale Road, Boise, ID 83713, phone 208/378-4900, www.biomark.com).

The expense of purchasing this equipment may be prohibitive for some facilities. For use in the U.S. Mexican wolf recovery program, the USFWS has purchased two Trovan units to be shared between institutions that do not own their own. In addition, InfoPet, the company that distributes the Trovan system, has a list of zoological facilities, universities and agencies that have the equipment. Since the recommendation for the use of the Destron System is very recent, currently there are no such provisions made.

Transponder numbers should be sent to the SSP© Coordinator for inclusion in SPARKS (Small Population Animal Record Keeping System) and should accompany paper work when a wolf is being transferred to another facility. It is not necessary to anesthetize the wolves to implant a transponder. The most common subcutaneous site to insert the chip has been between the shoulder blades. However, at least one facility has placed the transponder at the base of the ear. Wolf pups can be transponded in conjunction with the first scheduled vaccination.

Tattoos and transponders should be checked at least annually and preferably each time the animal is handled. Although such occurrences are rare, transponder chips have been known to migrate or otherwise fail.

Record Keeping:

Health, medical, dietary, reproductive, and mortality records for each animal should be kept in accordance with the holding facilities record keeping system (see Figure 6-A). Written daily reports should be maintained indicating the wolves' general condition, food consumption, bowel habits, animal interactions, etc. Copies of pertinent records should accompany each animal whenever it is transferred to another facility. Records should also be provided to the SSP© Coordinator, studbook keeper, and/or U.S. Fish and Wildlife Service upon request or whenever the facility feels there is something significant to report such as births and mortalities. Reports on reproductive status, mortalities, and transfers should be made monthly to the International Species Information System (ISIS) Record Keeper (see Figures 6-B). Please refer to Figure 6-C for the proper guidelines for Mexican wolf record keeping within the ISIS system. Additionally, each U.S. facility is required by their USFWS loan agreement to provide an annual report on all activities concerning their Mexican gray wolves to the SSP© Coordinator (see Figures 6-D and 6-E). In turn, the SSP© Coordinator prepares an annual report for AZA on the activities of the SSP©.

References (Referencias):

Kent Newton. 1995. Mexican Wolf Husbandry Manual. Mexican Wolf SSP Management Group.

Will Waddell. 1998. Red Wolf Husbandry Guidelines for Captive Management. Red Wolf SSP Management Group.

Figure 6-A Sample of an individual daily log.

Wild Canid Survival and Research Center
P.O. Box 760
Eureka, MO 63025
(636) 938-6490

Scientific name:	Canis lupus baileyi
Common name:	Mexican gray wolf
WCSRC accession #:	105
Studbook #:	105
Birth date:	07 May 1992
Sex:	Male
Sire/Dam:	Francisco #60/Sheila #37
House name:	"Alano"
Trovan identification	00-004F-7A11

Vaccination/Capture Record:

10/17/00 (Detroit Zoo) Netted and manually restrained for preshipment exam. Collected blood; vaccinated using Vanguard, DA2PL, modified-live parvo, killed rabies. Heartworm **Negative.**
10/10/01 **ANNUAL EXAM**
10/30/02 **ANNUAL EXAM**
10/14/03 **ANNUAL EXAM**

Medical Alerts:

SB#105 is monorchid as of birth on 07 May 1992.

Daily Log:

10/19/00 Received SB#105 from Belle Island on Northwest Airline Flight #1203. Animal in good physical condition upon arrival. Put in feeding area of enclosure E until several fecals come back clean. Will be introduced to SB#204 for the 2001 breeding season.
10/27/00 Diarrhea seen in holding area last few days. Fecal taken in to Dr. Armon's for check.
10/29/00 Alano still has diarrhea.
10/30/00 Diarrhea still not cleared up and appetite has decreased.

Figure 6-B Sample ISIS report.

Report Start Date 1/1/1601	Specimen Report for WCSRC / 9515	Report End Date 1/10/2004

Taxonomic name: *Canis lupus baileyi* — Family: Canidae

Common name: Mexican wolf — Order: Carnivora

Current information

Sex:	Female	Sire ID:	
Birth type:	Captive Born	Dam ID:	
Birth Location:	Arizona-Sonora Desert Museum	Rearing:	Unknown
Birthdate-Age:	16 May 1995 - 8Y,7M,29D	Hybrid:	Not a hybrid
Time since last Acq:	6Y,0M,15D as of report end date		

Date in	Acquisition - Vendor/local id	Holder	Disposition - Recipient/local id	Date out
28 Dec 1995	Loan In from ASDM TUSC / AF1510	WCSRC / 9515		

Date	Identifier type	Identifier	Location	Comments
15 May 1995	House Name	FRIJOLE		
15 May 1995	Regional Studbook #	204	UNKNOWN STUDBOOK	204 "International Studbook Number" from ARKS 2 records
6 Sep 1995	Transponder ID	00-001E-F84D		

Date	Note type	Comments
15 May 1995	Birth note	Born to female AF029 and male AF1182, removed for hand rearing.
29 Dec 1995	Acquisition note	Arrived via TWA at 8pm on Dec. 12 in good condition. Released into holding area of enclosure D.
16 Apr 2001	Litter/Clutch	Female SB#204 observed in den box appeared to be in labor. Keepers observed Frijole pick up pup covered in sack and carry into a hollow log up near den box. Did not see her come out of log. Keepers left, the next day she was observed in the den box where she remained until the 23rd of April. At this point she came out of the den box and behavior returned to normal. Never saw her return to box for nursing. Pup check was done on the 25th of April and we were unable to find any pup(s) or remains of pup(s).

Date	Enclosure	Reason
28 Dec 1995	D	Initially housed with male SB# 72, then with females SB# 169 and SB# 109.
6 Nov 1996	E	Still housed with females SB# 169 and SB# 106.
5 Nov 1997	G-1	Paired with male SB# 412.
14 Oct 1998	E	Continues to be paired with mate SB# 412 until he is removed and male SB# 105 is introduced on 10/19/2000.
10 Oct 2001	A	Transferred with mate SB# 105 in hopes that a more private enclosure will facilitate breeding success for the pair.

Date	Sex	Comments
28 Dec 1995	Female	

Date	Rearing	Comments
28 Dec 1995	Unknown	

Mexican Wolf Record Keeping Guidelines

In order to ensure that your ISIS records for Mexican wolves are recorded accurately, please refer to the following clarifications for verification of your historical records and guidance for future transactions.

Appropriate Entry of Studbook Number

The studbook numbers for Mexican wolves should be recorded under the Global Studbook identifier field.

Mnemonics, Acquisitions and Deacquisitions

- All Mexican wolves residing in the United States should be recorded as Loan-In from the U.S. Fish and Wildlife Service with the appropriate ISIS mnemonic USFWS. All records that currently reflect other ISIS or random mnemonics such as USDI, USDI-LAW, FOREIGN, etc. should be corrected to USFWS.

- All Mexican wolves residing in Mexico should be recorded as Loan-In from the "Secretaria de Medio Ambiente y Recursos Naturales" with the appropriate ISIS mnemonic SEMARNAT.

- Dispositions should be recorded as loan transfers to the next facility with their appropriate ISIS mnemonic and vendor/recipient ID.

- The receiving institution, if located in the United States, should record the acquisition as a Loan-In from the U.S. Fish and Wildlife Service (USFWS), while the receiving institution in Mexico will record the acquisition as a Loan-In from the "Secretaria de Medio Ambiente y Recursos Naturales" (SEMARNAT).

SEMARNAT is the revised ISIS mnemonic for all Mexican wolves residing in Mexico. The mnemonic designates the following government entity:

Secretaría de Medio Ambiente y Recursos Naturales
Direccion General de Vida Silvestre
Av. Revolución #1425 nivel 1
Col. Tlacopac
Mexico, DF 01040
MEXICO

This mnemonic will be included in the June 30th, 2003 DVD but you can enter the above-referenced information in your ISIS institution list prior to that date or you can use the previous mnemonic SEMARNAP. Since the mnemonic SEMARNAP has been set up as a synonym to the new mnemonic, SEMARNAT, your historical records will automatically be changed to the revised mnemonic once they are submitted to ISIS.

Transactions for Mexican wolves changing ownership from SEMARNAT to USFWS (traveling from Mexico to the United States) should be recorded as Loan-In directly from USFWS.

Transactions for Mexican wolves changing ownership from USFWS to SEMARNAT (traveling from the United States to Mexico) should be recorded as Loan-In directly from SEMARNAT.

Vendor/Recipient ID

There are currently two conventions for data entry of the vendor/recipient ID for a non-ISIS reporting facility in the Standards for Data Entry and Maintenance of North American Zoo and Aquarium Animal Records Databases, Page 86. Since the U.S. Fish and Wildlife Service uses the international studbook number for Mexican wolves as their internal accession number, the Mexican Wolf SSP© would like you to record the international studbook number (in its true form) in the vendor/recipient field as the USFWS unique ID.

Record keepers are encouraged to address any discrepancies or inconsistencies in their historic ARKS4 records. To facilitate this process, you can print a global taxon report for Mexican wolves from the ISIS website at www.isis.org in addition to your institutional taxon report.

These guidelines are to be incorporated into the Mexican Wolf Husbandry Manual.

File: MW Record Keeping Guidelines(1).doc 13 June 2003

Figure 6-D Sample Mexican wolf medical report.

2000
MEXICAN WOLF MEDICAL REPORT

Name of Reporting Institution:
Wild Canid Surv. & Res. Cntr.

PO Box 760, Eureka, MO 63025

Completed by: Susan Lyndaker Lindsey, PhD

Return by 17 July to:
Peter Siminski, Mexican Wolf SSP© Coord.
Arizona-Sonora Desert Museum
2021 N. Kinney Road
Tucson, AZ 85743
FAX: 520/883-2500
email: psiminski@desertmuseum.org

COMPLETING THIS REPORT WILL SATISFY THE REPORTING REQUIREMENT OF YOUR U.S. FISH AND WILDLIFE SERVICE LOAN AGREEMENT.

Complete this sheet for each wolf in your facility that has had a significant medical or behavioral problem or has died during the period 1 July 1999 through 30 June 2000.

Studbook number of the wolf: 058

Describe this individual's medical or behavioral problem; attach MedArks reports only if they are brief and informative:

Birthdate: 22 Apr 1987

Wolf shows evidence of having experienced a vestibular disorder (28 Sept 99) and has continued to show deficiencies on her left side. Recent evidence of low thyroid (17 June 00) and is receiving thyroxin

28 Sept 1999: Found in A.M. on opposite side of enclosure than normal; dazed, standing with rear legs splayed, circling and collapsing toward left side – symptomatic of stroke. Veterinarian suspected vestibular disorder/syndrome and administered steroids and fluids IV. In P.M. animal was a bit more stable in gait and alert; however, she remained disoriented with head tilt to left.

7 June 2000: Blood panel indicates early signs of thyroid condition.

Attach any necropsy reports not already submitted.

Thank You.

File: MW medical report 1.wpd

Figure 6-E Sample Mexican wolf reproduction report.

2000
MEXICAN WOLF REPRODUCTION REPORT

Name of Reporting Institution:
Wild Canid Surv. & Res. Cntr.

PO Box 760, Eureka, MO 63025

Completed by: Susan Lyndaker Lindsey, PhD

Return by 17 July to:
Peter Siminski, Mexican Wolf SSP© Coord.
Arizona-Sonora Desert Museum
2021 N. Kinney Road
Tucson, AZ 85743
FAX: 520/883-2500
email:psiminski@desertmuseum.org

COMPLETING THIS REPORT WILL SATISFY THE REPORTING REQUIREMENT OF YOUR U.S. FISH AND WILDLIFE SERVICE LOAN AGREEMENT.

Complete this sheet for each wolf pair together during the 2000 breeding season.

The pair: 284 (Male) X 547 (Female)

Date on which they were first housed together: 13 October 1999

Describe the breeding performance of this pair, e.g. compatibility, courtship, evidence of reproductive cycling, evidence of estrous, mating behavior, ties, denning, false pregnancies, births or signs of births, pup-rearing competency:

Male had been in several breeding situations in Mexico and the United States without producing offspring – including two seasons with a receptive female at Wild Canid. It was suggested that either he was dominated by his previous females or that he had reproductive problems. 284 was placed with 547 (an inexperienced and young female) on 13 October 1999; the introduction was unremarkable. Part of the Mexican Wolf Reproductive Study, behavioral data was collected on the pair throughout the reproductive season. They appeared to be a highly compatible and well-bonded pair. 547 showed typical estrous bleeding and repeated copulatory ties between the pair were observed for three days from 24-26 February 2000 (durations: 17min, 15min, 20min, 15 min). the female showed some evidence of weight gain and den digging but a relaxin assay performed mid-term (29 March) was negative (if reliable for Mexican gray wolves this blood test would indicate that 547 was not impregnated by 284). The female did not "go to den" and no evidence of pups was found at the time that would have been around term.

On 16 February and 1 March (before and after copulatory tie period was observed), 284 was captured and electro-ejaculated to evaluate his semen quality. Samples from both dates showed a large number of immature semen and many defects (proximal or distal droplets were prevalent). This male would be considered infertile; semen was very poor quality (75.5% motility, 92.5% living, but only 10.0% normal). Although 99 pellets are stores in the semen bank, most of the sperm in his samples were immature and methods do not currently exist to mature it outside of the living animal. Saric died from renal failure on 6 June 2000.

Failure to produce offspring attributable to reproductive problems of 284.

Describe the survival of each pup produced, e.g. stillborn, normal health, health or physical problems, death and cause with attached necropsy report. Account for every pup dead or alive. Refer to each pup by its studbook number.

Not applicable.

Thank You.

File: MW medical report 1.wpd

CHAPTER 7:
CAPTURE AND RESTRAINT

It is difficult to characterize or predict an individual wolf's response to a capture situation except that they are probably frightened and most likely stressed by the experience. A wolf may respond by lying quietly without much struggle or act defensively by "snapping" at anything close to its mouth. In order to achieve a successful and timely capture, keepers familiar with the habits of the wolves are vitally important to this operation. Appropriate animal keepers, curatorial, and veterinary staff should coordinate, in advance, all captures in a well planned manner.

Capture in a Confined Area:

One of the quickest and least stressful ways of capturing a Mexican gray wolf is to allow it to run into its den or other confined areas such as a holding or shift area. Once in this confined space, the wolf can be easily captured with a catch-pole, net, v-stick, or forced into a smaller handling crate. This method of capture underscores the importance of coordination with keepers familiar with the wolves' specific habits. Once the wolf has been observed running into the den, the entrance of the den should be blocked with a net or door incorporated into the den to prevent the animal from running out. At this point personnel familiar with the habits of the animal and proficient in the use of a catch-pole or v-stick can access the wolf from a rear den door, or from the top of a den equipped with a hinged or removable roof. The noose of the catch-pole can be slipped over the wolf's head and the animal secured by hand or using a net or v-stick. Most procedures (inoculation, blood draws, etc.) can normally be accomplished without removing the wolf from the den. Unless the animal is to be crated, it can be handled and then immediately released. If a large pack is being handled you want to leave the denned animals confined until all animals are processed in order to alleviate confused identifications and additional stress to the animal.

Capture in an Open Area:

Wolves that can not be captured in a confined area may require a larger coordinated effort with multiple keepers and nets. Personnel should form a line and move in a unified and deliberate fashion to corner or work the animal into a desirable location for capture. If the animal can not be worked into a corner of the pen for capture, the animal must be caught as it runs the perimeter of the pen. Do not chase the animal; position yourself so you can stick your net in front of the animal as it runs by you. Once the wolf is in the net, position yourself to follow through with the animal’s movement and place the net flat against the ground as soon as possible. To avoid further stress and possible injury from excessive struggling, the animal should be quickly pinned to the ground or against the fence by another member of the catch team using a tool such as a v-stick (CB). Unless the animal is to be crated it can be handled at the point or location of capture and then

immediately released. When capturing a large pack it is recommended that each animal caught in this manner be confined to a den area or crate until all the members of the pack have been processed.

Equipment:

Catch-pole - The type of catch-pole recommended is a 5 ft (180 cm) pole available from the Ketch-All Company. The ends of these particular snares have swivels which help to prevent the noose from twisting down around the wolf's neck. It is also recommended to add additional padding around the end of the catch-pole to prevent tooth breakage in case the wolf bites on the pole.

Prior to use, the plastic coating on the cable should be examined for wear or damage as this can cause the cable to stick inside the pole and fail to release properly. Replacement cable kits are available. It is advisable to have cable cutters available during a capture (high performance ratchet cable cutters are available at www.greenlee.com, PH: 800-435-0786 or International +1-815-397-7070).

Nets - A hoop net consisting of a 4-5 ft (120-150 cm) handle, a hoop opening of 36 in x 40 in (90-100 cm), and a 1-1 ½ in (2.5-3.75 cm) mesh nylon net with a depth of 4 ft (120 cm) is recommended. The mesh size of the net must be small enough to prevent feet and legs or noses from pushing through the net causing injuries.

The Wild Canid Center uses nets from Fuhrman Diversified, Inc. 2912 Bayport Blvd. Seabrook TX 77586-1501; PH: (281) 474-1388; www.fdiequipment.com [Heavy duty net system: rod diameter 5/8", circumference 84" Ogive; handle DSA1 Ti5A 48" double grip; net 84" circumference, 38" deep, brown, D mesh].

V-stick – A metal pole approximately 3 ½ ft (106 cm) tall, consisting of a cross bar at the top and a y-shaped fork at the bottom may also be used. The v-stick is utilized by placing it across the back of the neck of the wolf just in front of the shoulders applying a downward pressure, being sure to make contact with the ground on either side of the neck. This is typically done after the wolf has been secured by the catch-pole.

Crating:

Crating from a den or confined area - If the wolf is to be removed for transport, a crate should already be positioned, and ready outside the den as the animal is lifted or pulled from the den. The person holding the catch-pole is the person in control who coordinates the operation. 1. One method is to place the crate door at the den or shift door and attempt to run the wolf directly into the crate. 2. A second method would be to position the crate by standing it on end. The wolf is then lifted in a coordinated manner for placement into the crate. When the animal's hind quarters are above the crate, that end is released as the person controlling the catch-pole allows the weight of the wolf to drop into the crate. The noose should then be released and removed from the wolf's head and the crate lowered to its proper position. At no time should the wolf actually be lifted by the catch-pole, as injuries such as a broken hyoid bone can occur.

Crating from a net or an open area - 1. Position the crate along a fence line with the opening of the net abutted to the opening of the crate and force the wolf directly from the net into the crate. 2. Using a catch-pole pick the wolf up or "walk" the wolf into the crate. 3. If the wolf is too tangled in the net, it may be required to grab the wolf firmly by the scruff of the neck by hand to secure it while someone works to untangle the wolf and then transfer the wolf into the crate. Essentially, the hands act as a catch-pole; however, this may be the least desirable method for obvious reasons. It also may be possible to catch-pole the wolf from underneath the netting. 4. In some cases the transfer crate can be set in a corner of the pen and positioned in such a way that when the animal is forced to that corner it will seek refuge in the crate and can be captured without a great amount of stress. However, this may not be the best method if hands-on are needed prior to crating.

Handling:

During any capture or restraint of a Mexican gray wolf, the animal should be firmly but humanely handled. During handling, a Mexican gray wolf will undergo such procedures as inoculations, blood drawings, or a physical examination. Because sedation is not recommended or necessary for these types of procedures the animal has complete knowledge of the experience. It is essential that the Mexican wolf find the experience distasteful each time that it is touched by humans. Keepers may understandably feel a personal need to stroke, pet, or scratch a wolf behind the ears, etc., when the animal is restrained. A clear understanding of the Mexican gray wolf recovery objectives, and the potential problems associated with such actions should discourage such activity (e.g. a non-socialized animal will be further stressed by being stroked or petted).

Additionally, keepers should be carefully selected for their knowledge and temperament and must be aware of the overall purpose of managing these animals for release. One of the most harmful characteristic a keeper can show is fear of the animals. Wolves are sensitive to human emotion. Keepers must convey to the animals that, although there is respect for them, the keeper is in charge. If the wolves sense fear in their handlers, they may begin "testing" to determine how much control they have over daily situations and may eventually become more aggressive and unmanageable during restraint procedures.

Stress:

Stress and heat are the two main concerns when capturing Mexican wolves; therefore a capture should be coordinated with outdoor temperature in mind. Canids are extremely susceptible to overheating when stressed at temperatures above 80^{o}F (26.6^{o}C). The first indication of heat stress is generally excessive panting and drooling or a white frothy foam corporal around the mouth, reddened eyes, pale gums due to poor capulatory refill times (2 seconds or more), and in extreme cases vomiting. Work with the animal should cease until their respiratory and heart rates have returned to normal. If the animal has become comatose or there is a fear that it soon will, aid in reducing its body temperature by cooling it immediately with water from a hose or submerging the animal in cool water. Ice packs may be placed on the extremities or between the rear legs in the groin region

and rubbing alcohol may be poured on the pads and ears. IV fluid therapy may also be utilized to lower body temperature, which should be monitored throughout treatment. The normal body temperature range is between 99° and 104° F (37.2°C and 40°C). If the animal has already been captured, it should be placed in a well-ventilated holding crate in a shaded area or an air-conditioned building. The animal may be calmed by loosely covering the holding crate with a light shade screen which restricts exposure to sights and sounds without restricting ventilation. If covered, the animal should be periodically monitored. If the symptoms of overheating are observed and the animal has not been captured, attempts at capture should cease immediately. The veterinarian should determine if further attempts at capture can resume or should be postponed until another time.

Capture Myopathy (CM):

Although few deaths from capture myopathy have occurred in the Mexican wolf program, it has been encountered and needs to be treated by your veterinarian as a medical emergency. CM is a muscle disease associated with the stress of capture, restraint, and transportation. It is a syndrome that occurs in wild (free-ranging or captive) mammals and birds. It is thought that in nature capture myopathy is an inherent mechanism that hastens the death of an animal following capture by a predator. Four clinical syndromes of CM have been observed in animals, capture shock, ataxic myoglobinuric, ruptured muscle, and delayed-peracute. Capture shock may be observed in recently trapped or immobilized animals. Animals with this syndrome usually die within 1 to 6 hours post-capture. Various clinical signs associated with a capture shock death may include but are not limited to shallow rapid breathing, elevated body temperature, weak thready pulse, painful stiff movement of the hind legs, or death.

Prevention is the most effective means of managing CM. Under field conditions, the treatment of CM is usually unsuccessful. Numerous procedures may be carried out to reduce the potential for CM. However, CM may still occur, even with the most well-planned capture strategies. For treatment and control procedures, as well as, additional clinical and post-mortem signs (see Figure 7-A).

Bite Incident Procedure:

Mexican gray wolves are federally owned animals. Recent incidents of bites to staff and visitors have resulted in some confusion regarding jurisdiction when rabies control issues are implemented. Most authorities will agree to quarantine wolves for observation periods. However, some have requested or demanded euthanasia and necropsy examination of the wolf's brain. It is important to contact the MWSSP Coordinator and USFWS Mexican Wolf Recovery Coordinator as soon as possible after the incident occurs as they can assist in clarifying jurisdiction and authority issues. It is important that each facility have a good relationship with their County Health Department and share accurate information with them. The MWSSP Coordinator and USFWS Mexican Wolf Recovery Coordinator are available for consultation. The final decision resides with the

County Health Department since in all cases, public health will take precedence over individual wolf welfare.

It is recommended that all staff working with wolves receive the rabies vaccination with titres monitored every two years.

Escape Procedures:

Over the years there have been a number of reports of Mexican gray wolves that have escaped from their enclosures or facility. While each individual animal will react to such a situation differently, having in place a set of standardized procedures to follow will aid in a quick and safe recovery of an escaped wolf. The following procedural steps were adapted from the Red Wolf SSP© husbandry manual. They should be incorporated into your facility's own escape procedures.

1. If a wolf escapes a facility:
   - Immediately call USFWS MW Recovery Coordinator and MWSSP Coordinator, and again after the wolf returns to the facility or is recaptured. They may give special instructions or may be able to provide special assistance.

USFWS Maggie Dwire 505.761.4783 maggie_dwire@fws.gov
MWSSP Coordinator Peter Siminski 760.346.5694 ext 2103
psiminski@livingdesert.org

   - Every effort should be made to speak directly to the MWSSP Coordinator, regardless of the time of day, weekends, holidays, etc. If calls are made during normal business hours and you are given the option of leaving a message or staying on the line to speak to an operator; do both. Do not assume that the message will be retrieved immediately, so it is important to speak to the zoo operator. The Coordinator should be called, even if the animal has already been captured, to review details of the escape, what did (or did not) work, etc. Such communications will be valuable to the MWSSP should other escapes occur.
   - The facility should have all necessary equipment available, except for leg-hold traps. Equipment should include 3-4 functional wolf nets, catch poles, transfer crates, cap-chur or telinject equipment (gun, jab stick, drugs, etc.), current county road maps, hand-held radios and appropriate personnel available to handle any situation at any hour.
   - If some of this equipment is not available, the MWSSP Coordinator and FWS should be so advised, otherwise it will be assumed that the facility has sufficient equipment.
   - If a wolf leaves the facility property, it will likely travel where cover is available, e.g., along wooded streams, old roadways, path margins, etc. However, wolves will travel on roads with traffic.
   - Additionally, determining the availability of food in the form of road kills through appropriate agencies, e.g., State Wildlife or Transportation Department, etc., may prove helpful.

2. If the wolf escapes its pen but not the facility:
   - Call the MWSSP Coordinator after the wolf has been recaptured. The MWSSP Coordinator will contact USFWS.
   - When out of a pen, specific patterns that an escaped wolf will demonstrate may be extremely variable. This could be dependent on the property characteristics of the facility, how soon the escape is detected, what and when food is set out, etc. If the facility property contains wooded or other areas that may provide suitable shelter that is not heavily used by people, the animal may not go far immediately.
   - To increase the chances of keeping an escaped wolf (when visual contact has been lost) within the facility's perimeter fence and catching the animal, food should be provided at strategic locations, e.g., outside the pen where the animal escaped and at undisturbed places on the facility property, especially near natural runways such as old roads, paths, etc., as soon as possible. The food and the area around the food should be checked morning and evening for evidence of the presence of animals, including tracks.
3. Contacting the media will be at the discretion of the institution, unless acted upon otherwise by the USFWS.
   - There is no reason to involve the media if it is determined that the animal is still on the facility's property or if the animal is captured within 24 hours.
   - If it is determined that the animal has left the property and has not been captured within 24 hours, the public is owed the truth, i.e., an animal has escaped, we are attempting to capture it, and here are instructions to the public regarding their observations of the animal, (including a phone number to call and instructions for them not to attempt capturing the animal).
   - However, in all media contacts, efforts should be made to allay the public's fear to the degree possible. For example, inform them that the animal is shy and afraid of humans and that it is therefore not likely to be a danger. However, if cornered, it might respond aggressively to humans, and it might injure or kill pets for food or in defense.
4. A follow-up report from the MWSSP representative should be sent to the MWSSP Coordinator and the USFWS MW Recovery Coordinator.
   - This report should address important points such as how the escape occurred, what corrective measures will be taken, when the escape was detected, was food provided and when the Coordinator was contacted, news media interactions and response (attach newspaper articles), was the animal recaptured, when was it recaptured and how, was FWS called in and when, etc.
   - The purpose of this report is not to direct blame but to be used to evaluate these procedures and to minimize the likelihood of subsequent escapes and to maximize response and efficiency in future escapes.

References (Referencias):

Kent Newton. 1995. Mexican Wolf Husbandry Manual. Mexican Wolf SSP Management Group.

Will Waddell. 1998. Red Wolf Husbandry Manual Guidelines for Captive Management. Red Wolf SSP Management Group.

Figure 7-A

CAPTURE MYOPATHY

Capture myopathy is a muscle disease associated with the stress of capture, restraint, and transportation. The disease is characterized by degeneration and necrosis of skeletal and cardiac muscle. Other names for this disease include: exertional Rhabdomyolysis, muscle dystrophy, overstraining disease, capture stress disease, white muscle disease, and idiopathic muscle necrosis.

Numerous species of birds and mammals are susceptible to capture myopathy. It has never been documented in reptiles or lower vertebrates. It seems to be more prevalent in prey species or submissive members of non-prey species which can become easily excited, especially when exposed to unusual stress such as restraint or chasing.

The disease develops within hours and up to 14 days after capture or transport. It may be seen in both animals that exert themselves maximally and those that are relatively quiet although it generally occurs after severe exertion and is often seen following a difficult, prolonged capture. It can occur with either physical or chemical restraint.

Predisposing factors include fear, anxiety, overexertion, repeated handling, failure to allow an exhausted animal to rest before transportation, and constant muscle tensions such as may occur in protracted alarm reactions. A variety of stressors may function in concert or individually to precipitate development of the classical syndrome.

Four different syndromes related to capture myopathy have been described. These four symptoms are the peracute death syndrome, the acute death syndrome, the ataxic myoglobinuric syndrome, and the ruptured muscle syndrome.

The peracute death syndrome is seen in animals shortly after capture. While the animal is undisturbed, it appears normal, but if excited or stressed again, it may suddenly fall and die. A peracute muscle tissue breakdown, which causes a release of cellular contents, (particularly, lactic acid and potassium) is thought to be the underlying mechanism. The potassium causes the heart to be hypersensitive to substances released by the adrenal glands during stress. The heart develops a severe abnormal rhythm and death rapidly follows.

Acute death syndrome occurs 3-4 hours following capture and involves over-heating, shock, adrenal gland exhaustion, and mild, acute muscle breakdown. Alternations in blood pH to create an acidotic state appear to be a critical factor in the development of acute capture myopathy. Clinical signs that may be observed prior to death include depression, shallow rapid breathing, increased heart rate, cessation of urination, and rapid debilitation.

Ataxic myoglobinuric syndrome occurs hours to days post-capture. The animal becomes progressively more wobbly until it is unable to stand. The urine may appear reddish-brown in color due to the muscle break-down products. Renal failure follows.

In the ruptured muscle syndrome, animals are usually normal and appear healthy when captured, but clinical signs may become noticeable twenty-four to forty-eight hours later and may persist for three to four weeks. Clinical signs include a marked-drop in the hindquarters and hyperflexion of the hocks due to bilateral rupture of the gastrocnemius muscles.

The cause of all these syndromes is very similar but complex, involving fear, the sympathetic nervous system and damage to skeletal and cardiac musculature. The biochemistry of stress and fear create an atmosphere of increased metabolic activity and requirements. The muscles use up all available oxygen and resort to anaerobic glycolysis, a normal physiological process in muscle tissue. A by-product of glycolysis is lactic acid. Lactic acid is usually further metabolized in the liver to glycogen, but with sudden strenuous exercise, the massive increase of lactic acid creates a localized acidosis which progresses to a systemic acidosis.

The blood supply is pooled in the muscles and rapidly becomes deoxygenated. Normally, with exercise, there is a "muscle pump," whereby contractions squeeze blood out of the muscle and relaxation again allows pooling. When an animal is captured, there is now an isotonic state of contraction creating poor tissue perfusion and decreased heat dissipation and hypoxia. All of these problems are magnified when the animal is tranquilized and the muscle masses start to relax. A pooling of blood results in the venous system and a sudden drop in blood pressure occurs. Shock can become a complication as in the acute death syndrome. In most cases of capture myopathy, this hypoxia and local acidosis remains localized, especially in well-perfused muscle, and focal muscle necrosis results.

Capture myopathy is an unfortunate complication of immobilization, restraint, or transport. Prevention is very important by minimizing excitement that can result in overexertion. All immobilizations must be planned in advance to offset possible difficulty in post-anaesthetic recovery.

No reliable therapeutics have been documented to treat capture myopathy. Treatment for capture myopathy is supportive and includes intravenous fluids, sodium bicarbonate to combat acidosis, corticosteroids, vitamin E and selenium supplements, calcium channel blockers, and antibiotics. Many of the pathologic changes are irreversible and, despite drastic supportive measures, animals suffering from capture myopathy often die, so prevention is essential.

GUIDELINES FOR THE PREVENTION OF CAPTURE MYOPATHY AT AUDUBON ZOO

The following procedures are observed during all planned capture events:

1. Immobilizations are scheduled during early morning hours when temperature and humidity are lowest.
2. Each event is discussed by the veterinary and curatorial staff and a plan of action determined.
3. All necessary equipment is assembled and ready. Hospital staff are required to refer to a capture equipment check list.
4. All persons participating in the capture event will be trained in the use of equipment such as nets, snares, gloves, etc. Use of projective capture equipment is restricted to the hospital and curatorial staff.
5. When using chemical restraint, an adequate dose of the immobilizing agent is administered by the most efficient and least stressful method.
6. Blindfolds are used to decrease visual stimulation.
7. All personnel involved are to proceed quietly. Unnecessary conversation and noise are avoided.

8. All hospital, curatorial, and keeper staff are familiar with the human emergency protocol in the event of a narcotic accident. It is required that hospital staff, mammal curator, and assistant curator and hoofstock keepers be trained in CPR and that they keep their certification current by attending an annual review course.
9. [N/A to canids]
10. Temperature, pulse, and respiration rates will be checked during all restraint procedures.
11. Animals with temperatures greater than or equal to 106° F will be cooled down with water and receive IV fluid therapy if the condition is severe.
12. Animals showing increased heart rates (>250) or species seeming prone to capture myopathy may prophylactically be given one liter LRS containing 1,000 meq. sodium bicarbonate.

CHAPTER 8:
HEALTH AND MEDICAL CARE

Medical management of Mexican gray wolves should be limited as much as possible to preventative measures such as vaccination and parasite control and alleviating the suffering of ill or injured animals. In order to produce animals able to survive and reproduce in the wild, extraordinary measures like surgical repair of congenital defects or hand-rearing of pups are to be avoided. For SSP© participants, if possible USFWS should be notified prior to (not after the fact of) any major medical procedure. Complete medical records should be maintained on all Mexican gray wolves.

It is not possible to document all unforeseen management events, especially regarding medical/veterinary care. The following are guidelines based on the experience of the MWSSP, USFWS, and associated personnel. Each facility's veterinarian should inspect the animals visually on a routine basis and provide physical examinations for each animal at least annually.

Quarantine:

Whenever possible, Mexican gray wolves should be quarantined prior to introduction to the resident population. A thirty day quarantine period is recommended unless otherwise directed by the veterinarian. Ideally the wolf is held in a separate quarantine area away from the resident population. Appropriate disinfectants for equipment and foot baths should be used as directed by the veterinarian to reduce the spread of infectious agents. Quarantine is an appropriate time to perform a complete physical exam, evaluate for endo- and ectoparasites as well as hematological and serological evaluations. Serological evaluations should include serum chemistries and antibody titers against heartworm.

Parasite and Disease Control:

The prevalence of a particular disease or parasite common to Mexican gray wolves may vary by the geographic location and climate of the veterinarian's home facility. In general:

a) ***Adults:*** Previous medical records including past immunizations should be reviewed thoroughly upon an animal's arrival to a new facility. Vaccinations are generally given in the fall and prior to a transfer to a new facility.

1. Parasite Control - good sanitation including daily removal of feces from wolf enclosures greatly reduces the incidence of intestinal parasites in wolves. Fecal flotation, direct smears, and an Eliza test of intestinal parasites should be performed at least every three months or if an infestation is suspected and as a follow up to deworming procedures

following a positive fecal. Thorough surveillance is suggested just prior to breeding season to eliminate infestations in pregnant or lactating females.

2. Vaccinations - Mexican gray wolves should be vaccinated annually with canine distemper, hepatitis, leptospirosis, parainfluenza, and parvovirus (DHLPP) vaccine and a killed rabies vaccine. Modified live rabies vaccine should not be used on Mexican gray wolves. In some areas, vaccination against coronavirus or lyme disease may also be warranted at the discretion of the facility.

b) ***Pups:*** Mexican gray pups may be visually examined by the staff within the first two weeks that they are discovered. Check the number of pups, sexes and overall appearance. Unless there is a disease problem, it is recommended that handling be avoided until vaccinations begin at six weeks of age.

1. Parasite Control - Intestinal parasites are very common in wolf pups in some areas. Generally for canids, the suggested treatment is with oral strongid at 1cc/10 pounds (4.5kg) every two weeks beginning at 14 days of age through ten weeks of age. **Deworming of Mexican gray wolf pups should be in conjunction with scheduled vaccinations to eliminate additional handling; these begin at 6-8 weeks of age.** We normally do not start deworming earlier unless we have a reason to have hands on or think that there is a problem with the pups and deworming would be in their best interest.

2. Vaccinations - Mexican gray wolf pups should be vaccinated starting at 6-8 weeks of age, then every 2-4 weeks until the age of 16 weeks for canine distemper, hepatitis, leptospirosis, parainfluenza, and parvovirus (DHLPP) (see Figure 8-A). At 16 weeks of age, pups should also be vaccinated with killed rabies vaccine. Modified live rabies vaccine should not be used on Mexican gray wolves. At 20 weeks of age, pups may be given boosters; the institutional veterinarian will determine whether this step is needed based upon whether there have been recent regional outbreaks of a specific disease. In 1999, outbreaks of parvovirus were seen in the Yellowstone Northern Rocky Mountain gray wolf reintroduction and Arizona's Mexican gray wolves; 6-10% of domestic dogs have been shown to need a parvo vaccine booster for effective protection against parvovirus. In some areas, vaccination against coronavirus or lyme disease may be warranted at the discretion of the facility.

Endo- and Ectoparasites (see Figure 8-B for dosages)*:*

Roundworms (*Toxocara* or *Toxascaris* spp.), hookworms (*Ancylostoma* spp.), and whipworms (*Trichuris* spp.) are fairly common in Mexican gray wolves. They can be treated with any of several antiparasitic agents commonly used in domestic dogs such as Ivermectin, Strongid T (pyrantel pamoate), or Panacur (fenbendazole) given orally at standard canine doses. In areas where intestinal parasite infestations are especially common, prophylactic deworming can be done at the discretion of the facility's veterinarian.

Tapeworms (*Taenia* spp.) have been seen in Mexican gray wolves and have been successfully treated with oral or injectable Droncit (praziquantel).

The most commonly reported protozoan parasites in Mexican gray wolves are *Giardia* and *Coccidia*. *Giardia* may be treated with Metronidazole, Fenbendazole, or Albendazole. *Coccidia* may be treated with Corid (amprolium) or Albon (sulfadimethoxine) or other sulfa drugs (all at standard canine doses).

Mexican gray wolves should be tested annually for heartworm (*Dirofilaria immitis)*. Heartworm has been successfully treated in a Mexican gray wolf using Immiticide. Wolves that have tested negative should be treated with heartworm prophylaxis as commonly used for domestic dogs. Monthly treatment with Ivermectin or Micbemycin should be used during mosquito season. Ivermectin and Micbemycin are also effective against other internal parasites.

External parasites such as fleas and ticks are also seen in Mexican gray wolves. Infestations can frequently be managed by dusting or spraying areas used by wolves for resting with products containing carbaryl or pyrethrins. Severe infestations can be treated by dusting or spraying wolves with the same products. Treating wolf enclosures with a long-acting environmental spray like Duratrol (3M) is also recommended. Keeping enclosures mowed and well trimmed is also an effective means of controlling ectoparasites without chemicals. A 5% Sevin dust (carbaryl insecticide) is safe to use on canids, but a 10% dust is not. It should be lightly dusted into leaves, sleeping areas, etc.

Fly bites, especially to ear tips, is a common problem in Mexican gray wolves. In many parts of the country the problem fly appears to be the stable fly (*Stomoxys calcitrans*) which likes wet shaded areas in which to breed; however, the problem fly may vary with the location of the Mexican gray wolf facility.

Use of fly traps and fly strips have had limited success since they catch primarily non-biting flies; however, Sterling IPC traps specifically target stable flies and have been very effective at the Red Wolf Facility in Washington State. Smithsonian National Zoo has also had success attracting stable flies to a self-designed large white plywood box topped by a four-sided pyramid (see Figure 5-G) with all surfaces covered with clear, sticky fly paper ("Olson" or similar brand); the stable flies appear to be attracted to bright white.

Spraying enclosures and environs with insecticide sprays such as Dursban or Permethrins, combined with daily removal of feces, and prompt removal of uneaten meat will help control fly populations. Fly repellent gels such as Swat or Pet Forte can be applied to ears during normal physical examinations. Flea and tick control products such as "Advantix", "Defend ExSpot" and "Proticall" have had marked success preventing fly bites to ears at several facilities particularly if application is started prior to the fly bite season and when applications are made repeatedly (to the ears and body at approximately 3-5 week intervals as needed) for the duration of the season. As with any procedure, the need to repeatedly restrain in order to apply the product must be weighed against medical concerns, stress, and other risk factors. [Example: "Proticall" available

from Schering-Plough Animal Health (not the over-the-counter version) is 65% permethrin. Application is ½ tube to back of each ear and the rest of the dose applied to body.] Insecticide misting systems have also had some success at certain facilities. Proper disinfection, cleanliness, and chemical treatment in all areas of the facility will also have beneficial effects (See also Figures 5-C, 5-D, 5-E, 5-F, 5-G, 5-H.).

Common Medical Problems:

Very few medical problems have been reported in Mexican gray wolves. Careful observation of wolves and thorough records of all medical conditions, procedures and treatments will help to improve Mexican wolf medicine and husbandry and may also be an important tool in assessing any problems arising from the small genetic base of the population. The following are medical anomalies that have been documented in the captive population.

a) Stomach Torsion - Although few deaths from stomach torsion have occurred in the Mexican gray wolf program, it has been encountered and needs to be treated by your veterinarian as a medical emergency. Although some concern has been expressed that feeding a dry dog food may contribute to causing torsion, no studies have established a cause and effect relationship. In fact, many facilities have fed dry food to wolves for years without incidence. Some believe that stomach torsion is related to pacing or strenuous exercise on a full stomach, so care should be taken not to run or excite wolves for at least two hours after they have eaten.

b) Intermittent diarrhea - Intermittent diarrhea has been reported by several facilities holding Mexican gray wolves. Causes are suspected to be due to stress, dietary factors, or parasitism.

c) Ulcerative Pododermatitis - Foot pad ulceration can be a problem with captive wild canids. Foot sores are generally related to excessive time spent on rough concrete and can be prevented with housing modifications. Infected foot sores are usually associated with Staphylococcus spp. overgrowth and septicemia and can be treated with topical and/or systemic antibiotics.

d) Cryptorchidism - Unilateral and bilateral cryptorchidism has been reported in several Mexican gray wolves. Cryptorchid wolves appear to be non-reproductive; there is some debate regarding the reproductive viability of monorchid males. Semen collection has generally indicated that monorchid males are reproductively capable.

e) Progressive Retinal Atrophy (PRA) – A few cases have been seen in Mexican gray wolves. Retinal degeneration leads to blindness. Early symptoms include night blindness and unusually dilated pupils. In domestic dogs this disease is genetically linked. Cataract development can occur secondary to PRA. If you suspect PRA in one of your wolves please notify the SSP©.

f) Other conditions or anomalies that have been reported are: congenital heart murmurs from descendants of wolves #12 and #23, alopecia, positive ehrlichia titer, meritis and mastitis.

Physical Examinations:

A physical exam should be done annually when wolves are restrained for vaccination (see Figure 8-C for an example of a data form). This should include visual inspection of overall condition, ears, eyes, and teeth, palpation (including testes, prostate, and mammary gland), body weight, and auscultation of heart and lungs. Identification such as Trovan chips or tattoos should be checked for readability. Blood should be drawn for heartworm test, CBC and chemistry panel, and potential genetic tests. These same tests are recommended prior to transferring wolves between facilities.

Blood Banking:

Blood samples from every Mexican gray wolf are being reposited at the University of New Mexico for genetic data and historical value. Yearly exams are an opportune time to acquire blood from an individual who has not yet had a sample submitted to the repository. **Samples for pups of the year should be collected at their 16-week pup check. An adult need only be banked once in its lifetime; reminders will be sent out periodically as to which wolves still need to have samples submitted for banking.** The protocol for collecting and shipping the blood is as follows.

To collect blood in a purple tube top (blood mixed with anticoagulant):
Fill tube that has been marked with the individual's studbook number and the date of collection. Thoroughly, but gently roll (no shaking) to ensure the anticoagulant is distributed evenly and the sample will not clot. This can then be shipped as is, unfrozen, on wet ice to the address below; be sure and put enough ice in the shipment to keep it cool the entire time. A 2 ml sample is suggested (the lab will then partition this into four individual 0.5 ml samples stored in 0.5 ml nunc tubes).

To collect serum:
Collect blood in a red top clot tube and spin down. Transfer the serum to a 1.5ml nalgene cryovial marked with the individual's studbook number and the date of collection. Ship the sample on wet or dry ice to the address below. To date most shipments have been about 1.0 ml serum. It would be best if you can send two separate tubes per animal of at least 1.0 ml serum each for a total of 2.0 ml serum.

Please only use permanent ink to write on the cryotubes (e.g. Sharpies). Also, please clearly mark the box that samples are being shipped in as perishable and indicate whether or not to freeze or refrigerate the sample upon arrival.

Ship to:
Cheryl Parmenter
University of New Mexico

MSC03 2020, Dept. of Biology
Albuquerque, NM 87131
PH: 505-277-7808
Email: cparment@sevilleta.unm.edu
Phone contacts:

Curator of the division:
Dr. Joseph Cook
Museum of Southwestern Biology
Curator of Mammals and the Division of Genomic Resources
PH: 505-277-1358
Email: cookjose@unm.edu

OR Cheryl Parmenter
Collection Manager
Division of Genomic Resources
PH: 505-277-7808
Email: cparment@unm.edu

OR Main Museum Number PH: 505-277-1360

Anesthesia:

Since many medical procedures, including vaccination and blood sample collection, can and should be performed on manually restrained Mexican gray wolves, anesthesia should only be done in exceptional circumstances.

Telazol (5-7mg/kg) or Ketamine (7-10mg/kg) and Rompun (1-2mg/kg) in combination are recommended for anesthesia of adult Mexican gray wolves. Animals are generally restrained and hand-injected or injected via pole syringe or blow dart so the above doses are for IM injection. Doses for IV injection may be significantly lower.

Ketamine/Rompun anesthesia can be allowed to wear off through natural metabolism of the anesthetic agents, or the Rompun component can be reversed with IV injection of 5mg of Yohimbine. Recovery from both protocols can be accelerated with IV fluid therapy at 5-10 ml/kg/hr.

Animals can be maintained on Isoflurane, Halothane, or with additional injectable anesthetic agents for longer procedures. (See also additional anesthesia regimen guidelines in Figure 8-D.)

Physiological Norms:

Physiological norms and longevity for Mexican gray wolves are similar to those of other wolves and domestic dogs. Developmental data on puppies and typical adult

measurements are provided in Figure 8-E. Blood chemistry data from a 1989 study conducted at the Wild Canid Survival and Research Center are available in Figure 8-F.

What to Do if a Wolf Dies:

1. Notify SSP© and USFWS at earliest convenience.
2. Perform a complete necropsy by your institution or pathology service associate at your institution's expense.
3. Follow necropsy protocols as in Figure 8-G, and send reports and tissues to:
   a. MWSSP Pathologist Dr. Linda Munson at University of California, Department VM-PMI; 1126 Haring Hall, 1 Shields Ave.; Davis, CA 95616; PH: 916-754-7567; FAX: 916-752-3349; EM: lmunson@ucdavis.edu
   b. MWSSP Coordinator Peter Siminski, The Living Desert, 47-900 Portola Avenue, Palm Desert, CA 92260-6156; PH: 760-346-5694, ext. 2103; FX: 760-568-9685; Email: psiminski@livingdesert.org
4. Send the remainder of the carcass to the Museum of Southwestern Biology at the University of New Mexico in Albuquerque, NM.
   a. Be sure to include with the carcass information such as the studbook number of the specimen and date of death; a copy of the necropsy report can be affixed to the outside of the shipping container.
   b. Call for shipping instructions.
   Primary Contact: Collection Manager Jon Dunnum
   PH: 505-277-9262; Email: jldunnum@unm.edu
   Curator Dr. Joe Cook Email: cookjose@unm.edu
   OR the main office at PH: 505-277-1360.

Euthanasia and Post Mortem Protocol:

When it is determined that a Mexican wolf's health is compromised, consultation with the attending veterinarian, facility representative, the MWSSP Coordinator, the Mexican Wolf Recovery Coordinator, and other specialists if warranted, will occur regarding euthanizing a Mexican gray wolf. Therefore, these decisions will be made on a case by case basis and always with the welfare of an individual wolf and the overall objectives of the program in mind. In emergencies, the MWSSP's institutional representative and the veterinarian may together determine what is best for the animal in question.

Necropsies should be performed on all Mexican wolves as soon as possible after death. The approved necropsy protocol was formulated by Linda Munson, DVM, Ph.D., Veterinary Pathology Advisor to the Mexican Wolf SPP© and Canid, Hyena, Aardwolf Taxon Advisory Group of the AZA (see Figure 8-G). [Dr. Linda Munson, Mexican Wolf SSP© Pathology Advisor; Dept. VM-PMI, Haring Hall; School of Veterinary Medicine; University of California; Davis, CA 95616; PH: 530-754-7963; FAX: 530-752-3349, EM: lmunson@ucdavis.edu] Copies of the completed necropsy reports should be faxed or emailed to the SSP© Coordinator Peter Siminski, The Living Desert, 47-900 Portola Avenue; Palm Desert, CA 92260-6156; PH: 760-346-5694, ext. 2103; FX: 760-568-9685; Email: psiminski@livingdesert.org

References (Referencias)/Suggested Readings:

Marlene Drag. 1991. Hematologic Values of Captive Mexican Wolves. American Journal of Veterinary Research. 52(11): 1891-1892. *(Note: included in MWSSP husbandry manual as Figure 8-F)*

Kent Newton. 1995. Mexican Wolf Husbandry Manual. Mexican Wolf SSP Management Group.

Will Waddell. 1998. Red Wolf Husbandry Manual Guidelines for Captive Management. Red Wolf SSP Management Group.

Figure 8-A

Mexican Wolf Vaccination Protocol

PUPS:

8 weeks – DA2 PP (modified live)
distemper, adenovirus type 2, para influenza, parvovirus

12 weeks – DA2 PP (modified live)

16 weeks – DHLPP (DA2 PP with Lepto) and killed rabies vaccine

20 weeks booster – none required; institutional veterinarian determines need based on whether there have been recent regional outbreaks of a specific disease.

ADULTS:

Annually DA2 PP and killed rabies vaccine

Booster, if they have pups – Nordens CPV (modified live parvo virus) – 2-3 more times during the year. Each booster inhibits shedding of virus for 3 mo. – Pups less likely to pick up virus.

Figure 8-B Antiparasitic Treatment

Antiparasitics

Roundworms (ascarids) and hookworms-	
Fenbendazole (Panacur)	50 mg/kg orally for 3 days
Pyrantal pamoate (Nemex, Strongid)	5 mg/kg orally, repeat in 3 weeks
Ivermectin	0.2 mg/kg IM or orally – one treatment
Whipworms (trichuris)-	
Fenbenadazole (Panacur)	50 mg/kg orally once a day for 3 days, repeat dosing in 3 weeks and 2 months.
Tapeworms-	
Praziquantel (Droncit) – see package insert for weight based dosages	1 dose – available in oral and injectable forms do not use in pups less than 6 weeks of age
Coccidia-	
Sulfadimethoxine	50 mg/kg orally on day 1, then 25 mg/kg orally daily for 14-20 day
Amprolium	100 mg/kg orally for 7-10 days
Giardia-	
Metronidazole	50mg/kg orally once a day for 5 days
Heartworm Prevention-	
Ivermectin	.006 mg/kg orally once a month Commercial product – Heartguard, weight appropriate dose
Milbemycin	Commercial products – Sentinel and Interceptor Once a month, weight based dose Also treats round, hook, and whipworms.

Heartworm Treatment

Heartworm has been successfully treated in a Mexican gray wolf using Immiticide (68.64mg). The case involved a 7-year-old male weighing 62.4 pounds (slightly overweight). He tested positive for heartworm on snapp and direct tests. Treatment consisted of basic Immiticide treatment according to label use for canines. 68.64 mg Immiticide were given in right expaxial muscle at level of 4th lumbar vertebrae with a 21g 1 ½" needle and 3cc syringe. The dosage was repeated in 24 hours and the animal was kept in the Animal Care Hospital during treatment. (If

CBC and profile were not run at time of initial he Figure 8-C Sample medical/capture form
recommend you run these when you grab up the wolf to administer the Immiticide.) Blood work was repeated in 5 months and 3 yrs later-both test results were negative.

Wild Canid Center
P.O. Box 760
Eureka, MO 63025
(636)-938-5900

Date:_____

Species:_____
Vet:_____

Medical/Capture Record

Sex:_____ Studbook #:_____ House Name:_____

Transponder I.D.#:_____ Accession #:_____

Date of Birth:_____ Enclosure:_____

Distinguishing Markings:_____
_____

Reason for Capture:_____
_____
_____

Participants:_____
_____

Drugs Administered	Amount Administered	Time Administered

Temperature:_____ _____ _____ _____

Respiration/ minute:_____ _____ _____ _____

Weight:_____

Procedures	**Yes: comments**	**No: Comments**	**Results**
Bloodwork			
Vaccinations			
Worming			
Other			

Tests:_____
_____

Comments:_____

Figure 8-D Anesthesia Regimen Guidelines

Anesthesia

Listed below are anesthetic regimes that holding institutions have used successfully. Dose and regimen selected should take into account such things as: age, health, and environmental conditions.

Telazol (2-3 mg/kg) mixed with medetomidine (0.02-0.03 mg/kg) IM

Reverse with atipamazole (same volume as medetomidine)

- Supplement with oxygen.
- Induction is rapid and smooth, recovery can be slow but is smooth.
- Mild decrease in heart rate, respiratory depression not noticed.

Ketamine (4-5 mg/kg) mixed with medetomidine (50-70 mcg/kg) IM

Reverse with atipamazole

- Supplement with oxygen.
- Wait at least 45 minutes after inducing anesthesia before reversing the medetomidine.

Telazol (7-8 mg/kg) IM

Telazol (2.5 mg/kg) mixed with Ketamine (3.5 mg/kg) IM

Isoflurane and sevoflurane have been used to maintain an anesthetic plane.

Figure 8-E Average weights and measurements.

WEIGHTS AND MEASURES

APPROXIMATE BODY WEIGHTS

AGE	♀	♂
5 days	.9 kg	.9 kg
21 days	1.8 kg	1.8 kg
45 days	3.9 kg	3.9 kg
2 months	5 kg	5 kg
3 months	10 kg	10 kg
4 months	15 kg	15 kg
10 months	27 kg	30 kg
2+ years	28 kg	34 kg

APPROXIMATE ADULT BODY MEASUREMENTS

Tail length	39.4 cm
Ear length	11.7 cm
Shoulder height	67 cm
Total body length	143 cm
Hind foot length	23 cm
Front pad width	4 cm
Front pad length	7.6cm

Reprinted from the AMERICAN JOURNAL OF VETERINARY RESEARCH, Vol. 52, no. 11, Pages 1891-1892.

Figure 8-F

Hematologic values of captive Mexican wolves

Marlene D. Drag, DVM, MS

SUMMARY

Hematologic reference values were determined for a captive population of 11 Mexican wolves (*Canis lupus baileyi*). Wolf pups from 4 to 24 weeks old had progressive age-related increases in PCV, hemoglobin concentration, mean cell volume, and RBC counts similar to those seen in domestic dog pups (*C familiaris*). Hematologic indices in wolves older than 24 weeks were comparable to those of the adult domestic dog; however, PCV, hemoglobin concentration, and RBC counts were higher.

Mexican wolves (*Canis lupus baileyi*), a subspecies of gray wolf (C *lupus*), originally ranged from northern Mexico into Arizona and New Mexico.[1] The Mexican wolf recovery team estimated that < 30 wolves still lived wild in Mexico in 1982.[2] Mexican wolves have not been sighted in the United States in over 20 years. As of December 1989, there were 33 Mexican wolves in captivity in the United States and Mexico. Eleven of these wolves, protected by the US Department of Interior Fish and Wildlife Service, were housed at the Wild Canid Research and Survival Center, Tyson Research Center, Eureka, MO. Presently, these wolves are involved in a planned propagation study of the species that is expected to culminate with their reintroduction into the wild.

The purpose of the study reported here was to establish hematologic reference values for Mexican wolves. Knowledge of the reference ranges for hematologic values in nondomestic species may allow earlier diagnosis of disease, as well as recognition of causes of morbidity in the wild.

Materials and Methods

The wolves were housed in 0.2 to 0.65 hectare natural enclosures surrounded by chain link fencing. They were provided dry dog food[a] and water ad libitum. The food was treated with a heartworm preventive medication.[b]

Blood samples were obtained from 20 adult wolves (> 6 months old, 13 males, 7 females) in the autumn when routine physical examinations and vaccinations were administered. Blood was obtained from wolf pups (≤ 6 months old, 8 males, 5 females) during physical examinations conducted approximately every 2 weeks in the spring and summer. Adult wolves were captured and restrained with nets and v-shaped poles. Wolf pups were caught with nets and restrained by hand. Blood was obtained, using a 12-ml syringe and 20-gauge needle, from a cephalic, saphenous, or jugular vein. Actual time of restraint ranged from 5 to 10 minutes.

Samples for CBC were collected in evacuated tubes (3 ml)[c] containing EDTA. All samples were refrigerated and processed by a commercial laboratory within 24 hours of collection. These values were determined by use of an automate cell counter[d]: WBC count, RBC count, hemoglobin concentration, and mean cell volume (MCV). Calculated from the preceding values were: PCV, mean cell hemoglobin (MCH), and mean cell hemoglobin concentration (MCHC). Fresh blood smears for different leukocyte counts were stained with Wright-Giemsa stain and performed manually.

Results

Wolf pups from 4 to 24 weeks old had progressive age-related increases in PCV, hemoglobin concentration, MCV, and RBC count (Table 1). The MCH and MCHC values remained constant. The WBC counts fluctuated.

The PCV, hemoglobin concentration, and RBC counts in adult wolves were higher than those of adult dogs. The MCV, MCH, and MCHC values were comparable with those of dogs.[3] Higher WBC values also were seen in the adult wolves.

Received for publication June 6, 1990.

From the Wild Canid Research and Survival Center, PO Box 760, Eureka, MO 63025 and the Division of Comparative Medicine, Washington

University School of Medicine, Box 8061, 660 S Euclid Ave, St Louis, MO 63110.

[a] Purina Hi Pro, Ralston Purina Co, St Louis, Mo.
[b] Styrid-Caricide Liquid, Shering-Plough Animal Health, Kenilworth, NJ
[c] Becton, Dickinson & co, Rutherford, NJ.
[d] Coulter-S plus 4, Coulter Instruments, Hialeah, Fla.

Figure 8-F cont.

Discussion

The lower PCV, hemoglobin, MCV, and RBC values in 4-week-old wolf pups, and the subsequent increases associated with growth, were consistent with values observed in domestic dog pups.[4] Lee et al[5] attributed this phenomenon to the destruction of fetal erythrocytes that are replaced by mature erythrocytes. In domestic dogs, values continue to increase until adult values are reached at 9 to 12 months of age.[6] These age related changes were evident in the wolf pups; however, the increase over time was slower. The differences between wolf and dog pups may be species-dependent or may be the result of environmental factors. Hookworm infection had been documented in the enclosures when food intake fluctuated. Tick infestation also had occurred. These forms of chronic parasitism should result in microcytic anemia, characterized by a decrease in PCV, MCH, and MCV, and an increase in MCHC. Although lower PCV values were observed in the wolf pups, the MCHC and MCH were comparable with values in clinically normal dog pups. The MCV values in wolf pups were higher than values documented for dog pups. Seal et al[7] suggested that lower values in wild-caught gray wolf pups were the result of nutritional differences. The gray wolves that they studied were eating an all-meat diet, and possibly were not meeting their full growth potential.

Table 1—Hematologic values of Mexican wolves

Hematologic values	Weeks of age (n)							
	4(5)	8(10)	12(3)	16(5)	20(3)	24(7)	>52*(18)	>52†(23)
rbc ($\times 10^6/\mu l$)	3.8	4.5	3.9	4.9	6.0	6.5	7.4	6.6
PCV (%)	27.4	31.3	27.3	33.6	40.2	46.2	53.4	53.5
Mean cell volume (fl)	72.8	69.7	71.0	69.4	69.7	70.6	72.3	72.3
Hemoglobin (g/dl)	9.0	8.9	8.5	11.0	14.0	15.1	17.2	15.7
Mean cell hemoglobin (pg)	23.8	22.6	21.8	21.7	24.3	23.0	23.7	23.3
Mean cell Hb conc (%)	32.7	32.5	31.0	31.7	33.3	32.6	32.9	32.9
wbc ($\times 10^3/\mu l$)	15.7	13.2	16.5	12.7	15.1	14.5	12.0	15.0
Neutrophils ($\times 10^3/\mu l$)	9,650	7,495	12,008	7,879	6,221	8,962	8,096	12,044
Band neutrophils ($\times 10^3/\mu l$)	1,024	554	330	2,195	254	161	1,432	286
Lymphocytes ($\times 10^3/\mu l$)	1,890	3,432	2,481	4,036	6,319	2,773	1,373	1,835
Monocytes ($\times 10^3/\mu l$)	2,473	1,463	495	1,491	996	745	652	612
Eosinophils ($\times 10^3/\mu l$)	606	545	315	1,174	818	463	634	871

* Female Mexican wolves; † male Mexican wolves.
(n) = sample size. Hb conc = hemoglobin concentration.

Mexican wolves, given a commercial diet ad libitum, should reach their growth potential unless their dietary requirements vary from that of domestic dogs. Detailed dietary requirements of wolves are unavailable.

The RBC, hemoglobin, and PCV values of adult wolves were greater than the values observed in adult dogs.[3] Comparison of erythrocyte indices (MCH, MCHC, and MCV) with those of adult dogs failed to reveal differences. High RBC, hemoglobin, and PCV values with normal calculated indices indicated an increase in peripheral erythrocyte circulation. In dogs, excitement and strenuous exercise can cause contraction of the spleen, thus increasing the number of circulating RBC.[3] The capture process of Mexican wolves involved physical restraint, with most adult wolves captured after a short period of running. Exercise, fear, and excitement experienced by nondomestic animals during the capture procedure would likely provide the stimulus for splenic contraction. High RBC, hemoglobin, and PCV values appear to be normal in situations of excitement and physical activity.

Leukocyte counts in the wolf pups were inconsistent. Shifrine et al[8] reported that in Beagles, the WBC values decreased during the first 3 weeks of life then increased until the eight week. The leukocyte counts then decreased until the dogs were 4 years old and remained constant until they were 7 years old,[9] when increases were detected again. The inconsistency of the WBC counts in the wolf pups dictates that careful evaluation must be given to the clinical state of pups to be able to interpret the WBC values and their relationship to disease.

The leukocyte values of adult wolves were slightly higher than those of adult dogs. Exercise, excitement, and stress can cause an increase in the number of WBC in the circulation.[3] Athens et al,[10] attributed the

physiologic leukocytosis to epinephrine release that mobilized neutrophils i Figure 8-F cont.
Lymphocytosis can also develop in physiologic leukocytosis; however, the mechanis

In dogs, leukocytosis has also been associated with release of corticosteroids from the adrenal cortex in response to stress. Corticosteroids in dogs cause a leukocytosis consisting of neutrophilia, lymphopenia, eosinopenia, and monocytosis.[11] The values in our Mexican wolves suggested that this may have occurred. The slightly higher eosinophil counts could have been the result of hookworm parasitism in previous years, or their antigenic stimulation. As in Mexican wolf pups, analysis of WBC counts in adult wolves must be evaluated and compared with results of physical examinations to adequately assess the true state of the animal.

The objective of this study was to establish reasonable hematologic reference values in the Mexican wolf. The data showed that the hematologic values of the Mexican wolves housed at the Wild Canid Research and Survival Center were similar to those observed in domestic dogs. Physiologic stress may have influenced some of the values. Similar stress-related hematologic changes have been observed in bighorn sheep (*Ovis Canadensis*),[12] wild coyotes (*C latrans*),[13] and pronghorns (*Antilocaptra Americana*).[14] though the stress response was evident, knowledge of the expected range of normality should allow diagnosis of disease states.

References

1. Nelson EW, Goldman EA. A new wolf from Mexico. *J Mammal* 1929; 10:165-166
2. Mexican wolf recovery team. *Mexican wolf recovery plan*, US Fish & Wildlife Service, Denver Colo, 1982.
3. Jain NC. *Schalm's veterinary hematology*. 4th ed. Philadelphia: Lea & Febiger, 1986;103-113
4. Earl FL, Melvegar BA, Wilson RL. The hemogram and bone marrow profile of normal neonatal and weanling Beagle dogs. *Lab Anim Sci* 1973;23:690-695.
5. Lee P, Brown, ME, Hutzler PT. Blood volume changes and production and destruction of erythrocytes in newborn dogs. *AM J Vet Res* 1976;37:561-565
6. Bounous DI, Hoskins JD, Boudreaux MK. The hematopoietic system. In: Hoskins JD, ed. *Veterinary pediatrics*. Philadelphia: WB Saunders Co. 1990;293-301
7. Seal US, Mech LD, Van Ballenberghe V. Blood analyses of wolf pups and their ecological and metabolic interpretation. *J Mammal* 1975;56:64-75
8. Shifrine M. Munn SL, Rosenblatt LS, et al. Hematologic changes to 60 days of age in clinically normal Beagles. *Lab Anim Sci* 1973;23:894-898.
9. Dougherty JH, Rosenblatt LS. Changes in the hemogram of the Beagle with age. *J Gerontol* 1965;20:131-138.
10. Athens JW, Haab O, Taab S, et al. Leukokinetic studies. IV. The total blood, circulating and marginal granulocyte pools and the granulocyte turnover rate in normal subjects. *J Clin Invest* 1961;40:989-995.
11. Duncan JR, Prasse KW. *Veterinary laboratory medicine: clinical pathology*. Ames, Iowa: The Iowa State University Press, 1977;33-43.
12. Franzmann AW. Environmental sources of variation of bighorn sheep physiologic values. *J Wildl Manage* 1972;36:924-932.
13. Gates NL, Goering EK. Hematologic values of conditioned, captive wild coyotes. *J Wildl Dis* 1976;12:402-404
14. Seal US, Hoskinson RL. Metabolic indicators of habitat condition and capture stress in pronghorns. *J Wildl Manage* 1978;42:755-763

Figure 8-G

MEXICAN WOLF NECROPSY PROTOCOL

Am J Vet Res, Vol 52, No. 11, November

INSTITUTION/OWNER_____
ADDRESS_____
_____

CANID SPECIES_____ ANIMAL ISIS ID #_____
STUD BOOK #_____ SEX_____
BIRTH DATE/AGE_____ WEIGHT_____

REPRODUCTIVE HISTORY:
SHOWN BEHAVIORAL ESTRUS?_____
EVER BRED?_____
PRODUCED PUPS?_____
EVER HOUSED WITH OPPOSITE SEX?_____

DATE OF DEATH_____ DATE OF NECROPSY_____

HISTORY: (Briefly summarize clinical signs, circumstances of death.)

Please have your pathologist perform a histopathology on the tissues. Then send the gross examination worksheets and pathologist's report to Dr. Linda Munson, Mexican Wolf SSP© Pathology Advisor; Department VM-PMI, Haring Hall; School of Veterinary Medicine; University of California; Davis, CA 95616; PH: 530-754-7963; Fax: 530-752-

3349. Copies of the completed necropsy reports should be faxed to the SSP© Coordinator Peter Siminski, The Living Desert, 47-900 Portola Avenue; Palm De
PH: 760-346-5694, ext. 2103; FX: 760-568-9685; Email: psiminsk

Figure 8-G cont.

Animal ISIS ID#_____

GROSS EXAMINATION
WORKSHEET

PROSECTOR:_____

GENERAL CONDITION: (Nutritional condition, physical condition)
NEONATES: Examine for malformations (cleft palate, deformed limbs, etc.)

SKIN: (Including pinna, feet)

MUSCULOSKELETAL SYSTEM: (Bones, joints, muscles)

BODY CAVITIES: (Fat stores, abnormal fluids)
NEONATES: Assess hydration (tissue moistness)

HEMOLYMPHATIC: (Spleen, lymph nodes, thymus)

RESPIRATORY SYSTEM: (Nasal cavity, larynx, trachea, lungs, regional lymph nodes)
NEONATES: Determine if breathing occurred (Do the lungs float in formalin?)

CARDIOVASCULAR SYSTEM: (Heart, pericardium, great vessels)

DIGESTIVE SYSTEM: (Mouth, teeth, esophagus, stomach, intestines, liver, pancreas, mesenteric lymph nodes)

NEONATES: Is milk present in stomach?

URINARY SYSTEM: (Kidneys, ureters, urinary bladder, urethra)

REPRODUCTIVE SYSTEM: (Testis/ovary, uterus, vagina, penis, prepuce, prostate, mammary glands, placenta)

ENDOCRINE SYSTEM: (Adrenals, thyroid, parathyroids, pituitary)

NERVOUS SYSTEM: (Brain, spinal cord, peripheral nerves)

SENSORY ORGANS: (Eyes, ears)

<u>PRELIMINARY DIAGNOSES:</u>

Figure 8-G cont.

LABORATORY STUDIES: (List bacterial and viral cultures submitted and results, if available.)

Figure 8-G cont.

FIXED TISSUE CHECK LIST

Preserve the following tissues in 10% buffered formalin at a ratio of 1 part tissue to 10 parts formalin. Tissues should be no thicker than 1 cm. INCLUDE SECTIONS OF ALL LESIONS AND SAMPLES OF ALL LISTED TISSUES. For NEONATES, see the additional tissues on the NEONATAL PROTOCOL. Information on specific TISSUE SECTIONING PROCEDURES are on the following pages.

TISSUES TO SAMPLE (ALL TISSUES CAN BE PUT IN ONE CONTAINER):

Heart
Trachea
Thyroid/parathyroid glands
Lungs
Thymus
Lymph nodes
Spleen
Liver
Stomach
Small intestines
Pancreas
Large intestines
Adrenal
Kidneys
Urinary bladder
Testis/Ovary
Uterus
Brain
Skin
Skeletal muscle
Bone marrow
Long bone (if bone disease)
Spinal cord (if neurological disease)

FROZEN TISSUE: Store in plastic bags at –70 or –20 C for toxicology: Liver, brain, kidney, and (if possible) antemortem serum and plasma frozen. If you suspect an infectious disease, also freeze samples of small intestines, lung, spleen, and lymph nodes.

Figure 8-G cont.

NEONATAL NECROPSY PROTOCOL

Please follow the adult protocol in addition to the following:

1. Fix umbilical stump and surrounding tissues.

2. Examine of malformations (cleft palate, deformed limbs, heart defects).

3. Assess hydration (tissue moistness) and evidence of nursing (milk in stomach).

4. Determine if breathing occurred. (Do the lungs float in formalin?)

5. Check foot pads for erosions and ulcers.

Additional tissues for histopathology from neonates:

- All tissues from the adult necropsy check list
- Umbilicus (including external and internal vessels and surrounding skin)
- Foot pads from all feet.
- Extra sections of lung.

Figure 8-G cont.

RECOMMENDED TISSUE SAMPLING PROCEDURES

Adrenal glands: Entire gland with transverse incision.

Brain: Cut longitudinally along the midline. Submit entire brain and pituitary gland except for frozen sections.

Eye: Both eyes intact. Remove extraocular muscles and periorbital tissues.

Gastrointestinal tract: Open carefully along the long axis.

Esophagus - 3 cm long section
Stomach - multiple sections from cardia, fundus (body), and atrium of pylorus.
Small intestines - duodenum, jejunum, ileum
Large intestines - cecum, colon
Omentum - 3 cm square

Heart: longitudinal section including atrium, ventricle, and valves from (both) right and left heart. (Include large vessels.)

Kidney: Cortex and medulla from each kidney.

Liver: Sections from 3 lobes with capsule and gall bladder.

Lungs: Sections from several lobes including a major bronchus.

Lymph nodes: Cervical, mediastinal, bronchial, mesenteric, and lumbar cut transversely.

Opened rib or longitudinally sectioned half femur: Marrow must be exposed for proper fixation.

Oral/pharyngeal mucosa and tonsil: Plus any areas with erosions, ulcerations, or proliferative lesions.

Pancreas: Representative sections from two areas including central ducts.

Pituitary glands: Entire gland.

Reproductive tract: Ovaries and entire uterus with longitudinal cut into lumens of uterine horns. Both testes (transversely cut) with epididymis. Entire prostate, transversely cut.

Salivary gland:

Sciatic nerve: 3 cm section.

Skeletal muscle: Cross section of thigh muscle.

Skin: Full thickness of abdominal skin, lip, and ear pinna.

Spinal Cord: If neurological disease, sections from cervical, thoracic, and lumbar cord.

Spleen: Cross sections including capsule.

Thymus:

Thyroid/parathyroids: Leave glands intact.

Tongue: Cross section near tip including both mucosal surfaces.

Trachea:

Urinary bladder/ureters/urethra: Cross section of bladder and 2 cm sections of tubular structures.

SHIPPING TISSUES:

After at least 72 hrs in fixative, ship tissues in a leak-proof container in adequate formalin to keep tissues moist. Tissues can be shipped by U.S. Mail or UPS to:

Dr. Linda Munson
Mexican Wolf SSP© Pathology Advisor
Department VM-PMI, Haring Hall
School of Veterinary Medicine
University of California
Davis, CA 95616

PH: 530-754-7963
FX: 530-752-3349
EM: lmunson@ucdavis.edu

Figure 8-H

ISIS/MedArks Blood Values for the Gray Wolf (*Canis lupus)*

		ISIS Values				
		Mean	**S.D.**	**Min.**	**Max.**	**(N)**
WBC	*10^3/UL	9.707 ±	3.161	3.500	20.30	(420)
RBC	*10^6/UL	7.04 ±	1.32	3.65	9.99	(291)
HGB	GM/DL	16.5 ±	3.2	7.9	25.2	(317)
HCT	%	48.1 ±	8.4	23.0	67.8	(426)
MCH		24.5 ±	2.5	10.2	39.8	(265)
mchc		33.9 ±	3.4	17.6	46.6	(301)
MCV		70.3 ±	7.3	40.2	100.3	(273)
SEGS	*10^3/UL	7.036 ±	2.683	2.200	17.90	(409)
BANDS	*10^3/UL	0.198 ±	0.257	0.000	1.400	(100)
LYMPHOCYTES	*10^3/UL	1.570 ±	0.833	0.074	5.670	(415)
MONOCYTES	*10^3/UL	0.468 ±	0.345	0.000	2.136	(363)
EOSINOPHILS	*10^3/UL	0.661 ±	0.711	0.000	4.806	(382)
BASOPHILS	*10^3/UL	0.055 ±	0.072	0.000	0.336	(52)
NRBC	/100 WBC	0 ±	1	0	3	(70)
PLATE. CNT.	*10^3/UL	251 ±	85	69	544	(73)
RETICS	%	0.8 ±	0.7	0.1	2.1	(16)
GLUCOSE	MG/DL	124 ±	33	47	305	(347)
BUN	MG/DL	22 ±	8	6	72	(353)
CREAT.	MG/DL	1.2 ±	0.5	0.3	5.1	(347)
URIC ACID	MG/DL	0.4 ±	0.4	0.0	3.3	(120)
CA	MG/DL	10.0 ±	0.8	7.1	12.5	(336)
PHOS	MG/DL	3.8 ±	1.6	1.1	12.1	(294)
NA	MEQ/L	149 ±	5	128	182	(292)
K	MEQ/L	4.6 ±	0.5	3.1	6.8	(297)
CL	MEQ/L	116 ±	4	104	128	(277)
IRON	MCG/DL	149 ±	43	43	263	(61)
MG	MG/DL	1.65 ±	0.19	1.30	2.10	(30)
HCO3	MMOL/L	19.2 ±	3.4	13.0	25.0	(31)
CHOL	MG/DL	183 ±	65	56	447	(331)
TRIG	MG/DL	54 ±	39	15	248	(166)
T. PROT. (C)	GM/DL	6.2±	0.7	4.4	8.7	(328)
T. PROT. (R)	GM/DL	5.6 ±	0.4	5.2	6.4	(11)
ALBUMIN (C)	GM/DL	3.4 ±	0.4	2.4	4.6	(280)
GLOBULIN (C)	GM/DL	2.7 ±	0.6	1.4	4.7	(278)
AST (SGOT)	IU/L	48 ±	24	13	190	(324)

ALT (SGPT)	IU/L	54 ±	28	13	189	(345)
T. BILI.	MG/DL	0.2 ±	0.2	0.0	1.6	(281)
D. BILI.	MG/DL	0.1 ±	0.1	0.0	0.5	(89)
I. BILI.	MG/DL	0.2 ±	0.2	0.0	1.6	(88)
AMYLASE	SU	395 ±	178	107	876	(166)
LDH	IU/L	156 ±	142	14	876	(166)
CPK	IU/L	226 ±	173	32	864	(149)
OSMOLARITY	MOSMOL/L	305 ±	9	292	322	(34)
BODY TEMP.	°C	39.0 ±	1.3	36.0	43.2	(188)
CO2	MMOL/L	18.4 ±	4.2	9.0	30.0	(81)
ESR	MM/HR	0 ±	0	0	0	(1)
FIBRINOGEN	GM/DL	67 ±	58	0	100	(3)
FREE T3	PGM/ML	3.0 ±	0.0	3.0	3.0	(1)
GGT	IU/L	4 ±	3	0	13	(158)
LIPASE	U/L	217 ±	214	23	1095	(80)
PROGESTERONE	NG/ML	1.600 ±	0.424	1.300	1.900	(2)
Total Serum Solids (Refr)		6.7 ±	0.0	6.7	6.7	(1)
TT4 (RIA)	MCG/DL	1.5 ±	0.7	0.7	3.3	(26)
TT3 (RIA)	NG/DL	93.1 ±	44.6	31.0	197.0	(15)

Figure 8-H cont.

CHAPTER 9:
BASIC NUTRITION

General Considerations:

Mexican gray wolves must be provided with adequate quantities of fresh, high quality feed and clean drinking water at all times. In general, it is not the responsibility of Mexican Wolf SSP© cooperators to attempt to provide captive Mexican gray wolves with a diet consistent with what they would find in the wild. Biologists in the field and at pre-release site areas will assist the wolves in making the transition from a captive diet to natural prey items. Wolves selected as potential release candidates may be fed native wildlife when appropriate; the SSP© Coordinator and Management Group are to be consulted (see also Supplemental Feed Items). Body weight and daily feed consumption records should be maintained on all animals. Care must be taken to provide a consistent amount and type of diet. Diet changes for any reason should be made gradually; this is of particular concern when transferring animals between facilities.

Nutritional Requirements and Principal Diet:

Limited systematically collected information is available on the nutritional requirements for captive wolves. The nutritional requirements of Mexican gray wolves can be met feeding a high quality commercial (dry) dog food. Reports have indicated that wolves fed canine diets containing low to medium levels of energy have difficulty maintaining condition and tend to develop diarrhea. High quality extruded dog foods should be fed. Such meat based diets are high in digestibility and are less likely to result in the digestive upsets and diarrhea associated with high cereal diets. Although there is some disagreement as to what is a suitable canine diet, the 1998 version of the Mexican Gray Wolf Husbandry Manual reports nutritional guidelines for protein as 20-25%, and fat at 5%. However, many facilities with good success breeding Mexican grays use diets which exceed these recommendations.

Nutritionists and wild canid managers have long recognized the need for the development of a dry diet which could meet all the nutritional needs of the captive wolf. A 1994-95 study conducted at the Wild Canid Survival and Research Center helped facilitate the development of such a diet. Mazuri Exotic Canine Diet (5MN2) with 28.5% protein, 18% fat, and 4.0% fiber, was developed by Purina Mills, Inc. specifically for the feeding of canids requiring a high energy diet and where a low fecal volume is desired. The objective of this study was to evaluate this diet as a ration for endangered wolves maintained in naturalistic enclosures and to obtain documentation as to feed consumption and fecal quality. All wolves participating in the study maintained good general condition and showed dramatic improvements in fecal quality (see Figure 9-A for copy of AZA publication).

All adult Mexican gray wolves weighing 48.4-70.4 lb (22-32 kg) should be fed approximately 1,300 to 1,800 kcal of metabolizable energy (ME) per day for maintenance in a thermoneutral environment with moderate activity. This amount of ME would be supplied by 0.63 oz (18g) of good quality dry dog food (3.3 kcal ME/g) per kilogram of body weight (1.5 - 2.5 lb or 0.68-1.13 kg of food per day per wolf). Energy requirements will vary with climate, activity level, and individual animal.

No more than a three months supply of the diet should be purchased at one time; it should be stored in a cool dry place to ensure that it will be fresh and free of rancidity. Vitamin and mineral deficiency or toxicity is extremely rare in wolves fed a high quality diet. Nutritional imbalances in Mexican gray wolves are most likely to be caused by feeding a diet consisting wholly of organ or muscle meats. Such diets are very low in calcium and have significant deficiencies or imbalances of other nutrients.

Supplemental Feed Items:

If a high quality, meat based dry dog food is used as the principal diet, supplements are unnecessary. Feeding large quantities of supplemental items such as prepared meats or carcasses is not recommended. Prepared meats like a commercial carnivore log are commonly used to entice finicky eaters, or for "pilling" or administering oral medications.

Care should be taken not to feed these items in high enough quantity as to interfere with the balanced composition of the principal diet.

Bones such as beef or horse shank and knuckle bones may be fed but on a random basis. These are valuable environmental/behavioral enrichment, promote good dental health, and may aid in strengthening cranial muscle and bone. However, cow and horse bones should not be fed to potential release candidates. They should be fed natural prey items only.

Dietary vitamin and mineral supplements such as Pet Tabs are fed by some facilities but do not appear to be essential for normal animal maintenance if a good quality diet is fed.

Recent discussions amongst SSP© cooperators and the MWSSP Management Committee have reached a consensus that supplemental feeding high priority release candidates with carcasses of native prey items (e.g., wild rabbit, javelina, elk, white-tailed and mule deer) would be beneficial. It is thought that this exposure to native prey would help the wolves to develop relevant skills associated with high survivability in the wild. Feeding carcasses of a domestic livestock nature (e.g., chicken, cattle, goat, sheep, horse, donkey) is not permitted as this may lead to wolf/livestock – and livestock owner – conflicts after release. In addition, regular feeding of carcasses to animals that are to remain in captivity is also not recommended due to an increased risk of exposure to pathogens.

Nutrition and Reproduction:

Good nutrition is essential to successful breeding and pup rearing. Facilities that have good success breeding Mexican wolves begin reproductive-related diet changes near the beginning of estrus as indicated by the pro-estrus bleed. Facilities may increase the amount of dry feed or supplement with prepared meat diets.

Pregnant bitches have energy requirements approximately 30% higher than maintenance requirements during the last third of pregnancy. Lactating wolves need two to three times the energy needed for maintenance. A high quality, energy dense diet must be fed at these times. Female wolves with these high nutritional needs cannot eat a large enough quantity of poor quality diets to meet their needs. Frequency of feedings should be increased to two to three feedings a day during these high demand periods. Pregnancy and lactation also increase daily requirements for nutrients such as protein and calcium, but increased food consumption to meet energy needs automatically increases food intake of these nutrients. Therefore, supplementation of a properly formulated diet with minerals and vitamins, is unnecessary, and unless done properly, may cause more harm than good.

Hand-Rearing Guidelines:

As a rule, wolf pups are only removed for hand-rearing in extraordinary circumstances and with prior approval of the USFWS. The genetic value of the pups will need to greatly outweigh the domesticating influences of hand-rearing. (When approval has been granted for hand-rearing, see Figure 9-B for the recommended protocol.)

References (Referencias):

Susan Lyndaker Lindsey and Dan Hopkins. 1995. Analysis of a New Diet for Mexican Gray (*Canis lupus baileyi*) and Red (*Canis rufus gregori*) Wolves. 1995 AZA Regional Conference Proceedings, p. 295-299. AZA, Oglebay, WV. ***(Note: Included in Mexican Wolf SSP Husbandry Manual as Figure 9-A.)***

Kent Newton. 1995. Mexican Wolf Husbandry Manual. Mexican Wolf SSP Management Group.

Will Waddell. 1998. Red Wolf Husbandry Guidelines for Captive Management. Red Wolf SSP Management Group.

ANALYSIS OF A NEW DIET FOR MEXICAN GRAY (*Canis lupus baileyi*) AND RED (*Canis rufus gregoryi*) WOLVES

Susan Lyndaker Lindsey, Ph. D.
Executive Director
Wild Canid Survival and Research Center
P.O. Box 760
Eureka, MO 63025

Daniel T. Hopkins, Ph. D.
Director Specialty Research
Purina Mills, Inc.
P.O. Box 66812
St. Louis, MO 63166

Limited systematically collected information is available on the nutritional requirements and suitable feeding programs for captive wolves. Historically, many private facilities fed meat obtained through various methods to adult wolves, and pups were reared on standard canine milk replacer. In both cases, the nutritional needs of the animals were often not met (Mech, 1970; Lyndaker, 1980; Vainisi et al. 1981). Dry omnivore and canine rations have been used with some success in many zoological institutions housing endangered wolves.

Anecdotal reports indicate that wolves fed canine diets containing low to medium levels of energy have difficulty maintaining condition and tend to develop diarrhea. While this has not been well documented, these observations are consistent with what might be expected from feeding low energy diets, which are not highly digestible, to active animals with a high requirement for energy and a high level of feed intake as compared to most domesticated canines. Generally, those housing wolves would agree that low quality "budget" dog foods are undesirable. However, there is some disagreement as to what is a suitable canine diet. Draft husbandry manuals for red wolves (*Canis rufus gregoryi*) (Waddell, 1994) and Mexican grays (*Canis lupus baileyi*) (Newton and Dinon, 1994) currently outline somewhat different nutritional guidelines (Protein: red, 21-22%; Mexican, 20-25%; Fat: red, 8-13%; Mexican, 5%; Fiber: red, 2%; Mexican, none given). However, many of the facilities with good success breeding Mexican grays use diets which exceed these recommendations. In fact, a Mexican gray wolf husbandry survey (Newton and Dinon, 1993) found that six of the ten reporting facilities clearly utilize diets exceeding 25% protein and five supplemented various dry rations (which may have already exceeded the reported guidelines) with Nebraska Brand canine or feline diet. With this addition, the fecal quality often improves but the meat attracts flies with concomitant problems from fly strikes. The development of a dry diet which could meet all the nutritional needs of the animals and husbandry goals would be very desirable.

Mazuri Exotic Canine Diet (5M52), with 28.5% protein, 18% fat, and 4.0% fiber, was developed specifically for the feeding of canids requiring a high energy diet and where a low fecal volume is desired. The objective of this study was to evaluate this diet as a ration for endangered wolves maintained in naturalistic enclosures and to obtain documentation as to feed consumption and fecal quality.

BACKGROUND

Palatability and digestibility trials for Mazuri Exotic Canine Diet (5M52) were completed (Hopkins and Roselina, 1993) using beagles (*Canis lupus familiaris*). In the palatability trial, Mazuri Exotic Canine Diet was preferred 2.1:1 over a leading high density competitive product (Analysis: 25% protein, 15% fat, 3% fiber) by 20 animals. Digestibility trials with six adults

resulted in the following values: dry matter 85%, protein 87%, fat 97%, energy 90%, metabolizable energy, 4.06 Kcal/gm. A growth study conducted with 10 beagle puppies demonstrated that the product supported satisfactory growth (Hopkins and Roselina, 1993). This was a good indication that the diet was nutritionally complete and ready for testing in exotic canids.

In 1992-1993, the Mazuri Exotic Canine Diet was fed to 30 gray wolves as part of a wolf contraception study at the Wildlife Science Center at Forest Lake, Minnesota (Hopkins and Roselina, 1993). The feed was furnished as part of an overall study in which an oral contraceptive was evaluated. Wolves fed Mazuri Exotic Canine did well, had good hair coats, bright eyes and their fecal quality was excellent as measured by low volume, firmness and the absence of diarrhea. Reproduction in the control group (those not receiving the oral contraception) was satisfactory and they raised pups successfully while on the diet.

METHODS

Mazuri Exotic Canine Diet was fed to selected endangered red and Mexican gray wolves at the Wild Canid Survival and Research Center as the sole regular source of diet. Diet was treated with Caricide (diethylcarbamizine) onsite to prevent heartworm. Previously to being fed Mazuri Exotic Canine, manufactured by Purina Mills, Inc., the study wolves had been fed HiPro (not more than 27% protein, 10% fat, 4.0% fiber) manufactured by Ralston Purina Company which had been treated with Caricide prior to delivery. All wolves were healthy and doing well on the HiPro diet; however, fecal quality was less than desired.

Subjects: Four groups of wolves received Mazuri Exotic Canine for varying time periods from spring 1994 to present. The four groups of animals included in the study to date are:

Pair of adult Mexican gray wolves (1.1)
Received diet: 7 May through 20 November 1994
Male Studbook #89, birth date 29 April 1991
Female SB# 109, birth date 7 May 1992

Pack I of red wolves (2.3; mother and four offspring)
Received diet: 13 May 1994 through March 1995
Female SB# 483, birth date 10 May 1991
Male SB# 625, male SB# 627, female SB# 628,
Female SB# 629; all born to SB#4823 on 3 May 1993

Pack II of red wolves (3.0; father and two offspring)
Received diet: 26 August 94 through present
Male SB# 350, birth date 3 May 1998, father to
Male SB# 615, male SB#616, birth date 27 April 1993

Pack I of Mexican gray wolves (currently 2.4; alpha pair, yearlings and expected pups)
Received diet: 16 December 1994 through present
Male SB# 60, birth date 15 April 1988;
Female SB# 37, birth date 15 April 1984;
Male SB# 166, female SB# 167, Female SB# 168,

Female SB# 169, all born to SB# 60 and SB# 37
27 April 1994; pups expected late April 1995

Housing: The Wild Canid Survival and Research Center, founded in 1971 by noted naturalist Dr. R. Marlin Perkins, is a private, nonprofit conservation organization dedicated to the preservation of the wolf and its place in the natural ecosystem. It is located on fifty isolated, wooded acres (20.24 ha) within Washington University's 2000 acre (809.7 ha) Tyson Research Center approximately 20 miles (32.26 km) southwest of St. Louis, Missouri. This small facility has had significant success in breeding endangered red and Mexican gray wolves for federally sanctioned recovery efforts. The study animals were housed within enclosures of varying size (from approximately 0.2 to 2.5 acres; .081 to 1.01 ha) within two wolf complexes. All exhibits have natural substrate and vegetation; most exhibits have a man-made pond. Animals could excavate their own dens or use man-made dens or houses for protection against the weather. All enclosures have double-door keeper systems and shift areas for safety. Diet was placed in trays housed within metal feeders of standard height (36 in; 92 cm) according to the number of animals housed within that exhibit. Fresh water was always available in metal tubs (#3, 15 gal; 5.68 dal). Bones were provided weekly. All animals had the opportunity to depredate within their enclosures. Common prey items include mammals (primarily rabbits, raccoons, and opossum), rodents, birds (primarily passerines, waterfowl, grouse, and turkey), reptiles, and fish.

Procedure: Each animal was offered 2 pounds (.906 kg) of diet each morning in a communal feeder. Conversion from the HiPro diet to the new Mazuri Exotic Canine diet was done gradually over a six day period. In all cases, the animals readily consumed the Mazuri Exotic Canine Diet and often did so preferentially leaving behind what HiPro could be separated easily from the new chow. Feces were graded according to a set evaluation schedule at least weekly for the first month and monthly thereafter. The fecal scale used is common to the pet food development industry and was as follows: A. well formed; B. poorly formed; C. a pile, but no form; D. semi-solid; E. a pool of water.

RESULTS

Diet conversion and fecal ratings during Mazuri consumption were as follows:

A. Mexican gray wolf pair.

7 May 94	Begin conversion to Mazuri
12 May 94	Mazuri only
19 May 94	B
26 May 94	B
2 June 94	B
8 June 94	B
29 June 94	B
8 July 94	B
8 Aug 94	A
	Completion of 90 day study
25 Aug 94	A
27 Oct 94	B
20 Nov 94	Switched back to HiPro; impending transfers

22 Nov 94	Diarrhea reported

B. Red wolf pack I.

13 May 94	Begin conversion to Mazuri
19 May 94	Mazuri only
26 May 94	A
2 June 94	C
8 June 94	B
29 June 94	A
8 Aug 94	A
25 Aug 94	A
	Completion of 90 day study
Sept 94	No data collected
27 Oct 94	A
11 Nov 94	A
23 Dec 94	A
14 Jan 94	Pack separated (males from females) for breeding season
April 94	Will reform pack and resume data collection

C. Red wolf pack II was converted gradually to the new diet beginning on 26 August 1994 and were totally on the new diet as of 1 September 1994. This pack was not part of the original 90 day planned study but was added for management reasons. The adult male had been losing weight and it was thought that he might do better on the Mazuri diet. Although he had tested positive for hookworms on 21 August 94 and the pack was successfully treated, there was also some behavioral evidence that his weight loss might be related to aggression from his offspring. A second feeding station was added to decrease competition and Mazuri was offered. The adult male had visibly increased appetite and weight by 6 Sept 94. The second feeder was removed within a few weeks because it received few visits from the pack. This pack, which continues to be fed Mazuri, has maintained good condition and fecal ratings in the “A” and “B” categories.

D. Mexican wolf pack I (Breeding group 2.4).

Dec 94	Receiving HiPro, C (average; D and E also found)
16 Dec 94	C, yellow; begin conversion to Mazuri
22 Dec 94	Mazuri only
23 Dec 94	B, color change to dark brown
30 Dec 94	A
6 Jan 95	A
13 Jan 95	B
20 Jan 95	A
27 Jan 95	A
3 Feb 95	A
10 Feb 95	A
17 Feb 95	B
24 Feb 95	A
3 Mar 95	A
10 Mar 95	B

DISCUSSION

Both Ralston Purina's HiPro dog food and Purina Mills, Inc.'s Mazuri Exotic Canine Diet maintained wolves in good condition. However, during the period of comparison fecals were of a more desired consistency for those animals receiving the Mazuri diet.

All wolves participating in the Mazuri 90-day study (pair of Mexican grays and pack I of reds) and those currently fed the new diet (pack II of reds and pack I of Mexican grays) have maintained good general condition. Per visual inspection, hair coat was consistent and no animal appeared to gain or lose weight, although none were weighed during the 90-day study. All animals had good "brightness of eye"; however, the usual summer allergy eye drainages were experienced with the pair of Mexican gray wolves. The most striking effect was the feces, which improved quickly once the new diet was begun. The fecals for study animals were distinct piles and either well or at least somewhat formed; none were watery. This was in contrast to the droppings of wolves fed regular commercial dog food; their fecals were often either watery or semi-solid.

This will be the first breeding and pup rearing seasons when breeding packs at the Wild Canid Survival and Research Center have not received HiPro supplemented with Nebraska Brand Canine Diet. Additional data, including weights, for the Mexican gray pack will be available from the authors by winter 1995.

ACKNOWLEDGMENTS

The Wild Canid Survival and Research Center gratefully acknowledges the donation of feeds from both Ralston Purina and Purina Mills, Inc. Ralston Purina has donated Caricide treated feed since Marlin Perkins first founded the WCSRC in 1971. Purina Mills, Inc. donated the Mazuri Exotic Canine diet and Caricide for the experimental groups. Keepers Kim Bishop, Jim Hunter, Rachel Garcia, Steve Allain, and Deborah Bear all helped collect fecal scores. Dr. William Armon, Kim Bishop, Frank Olive, Dave Payne, and Rich Zerillo assisted in obtaining baseline weight information for the Mexican gray wolf pack.

REFERENCES

Hopkins, Daniel T. and Angel C. Roselina. 1993. *Research results for Mazuri exotic canine diet 5m52.* Private communication. Purina Mills, Inc.

Lyndaker, Susan M. 1980. *The development of begging and regurgitation in wolf (*Canis lupus*) pups.* M.A. Thesis. Southern Illinois University, Carbondale, IL.

Mech, L. David. 1970. *The wolf: the ecology and behavior of an endangered species.* Natural History Press, Garden City, NY.

Newton, Kent and John Dinon. 1993. *Mexican wolf husbandry survey summary.* Report to the Mexican Wolf Captive Management Committee.

Newton, Kent and John Dinon. 1994. *Mexican gray wolf husbandry guide* Figure 9-A cont.
Mexican Wolf Captive Management Committee and Mexican Gray Wolf SSP.

Vainisi, Stephen J., Henfry F. Edelhauser, E. Dan Wolf, Edward Cotlier, and Frederick Reeser. 1981. Nutritional cataracts in timber wolves. *J. American Veterinary Medical Association.* 179(11):1175-1180.

Waddell, Will. 1994. *Red wolf husbandry guideline, 2nd draft.* Red Wolf SSP Management Group.

Hand-Rearing Guidelines

As a rule, wolf pups are only removed for hand-rearing in extraordinary circumstances and with prior approval of the USFWS. The genetic value of the pups will need to greatly outweigh the domesticating influences of hand-rearing.

Whenever possible, cross-fostering of pups would be preferred to pulling pups for hand-rearing. In cross-fostering, pups would be placed with those being cared for by a competent proven female at the same institution or another institution with a suitable match. Consultation with and approval from the USFWS Mexican Wolf Recovery Coordinator and MWSSP Coordinator are required as with hand-rearing.

If the pups are removed before they have suckled, they will not have received any passive immunity from their mother's first milk. The pups need to be provided with their passive immunity, and this can be done in two ways. First, the mother can be milked for her colostrum which can then be fed directly to the pups. Second, 3cc to 5cc of mother's blood serum can be injected subcutaneously to each pup. The serum can be administered a few days after they have received their colostrum or twice the first week if colostrum is not available.

The pups should be fed an unmodified Esbilac formula. The amount of formula fed per twenty-four hour period should total about 20% of the pup's body weight. For example, a 700 g (24.5 oz) pup should receive 140 g (4.9 oz) or 140 ml (4.2 oz) of formula, divided into several evenly spaced feedings, per twenty-four hour period. A regular human infant nipple works well. Heat only the amount measured for each feeding to body temperature. At three weeks of age begin to offer milk-soaked puppy chow, and then wean them from the bottle.

Until the pups are at least twenty-one days old, they should be kept in an environment above 85°F (29°C). A pup's rectal temperature should be about 100°-101°F (37.8°-38.3°C).

Document the feeding schedule, the amounts of formula offered and taken at each feeding, the stool condition, and daily weights. Vaccinate according to schedule.

On the few occasions when hand-rearing was necessary in the Mexican Wolf SSP©, the pup(s) were placed with a suitable wolf companion at as early an age as possible. Socialization to humans is very undesirable and not compatible with the goals of the recovery program. Recommendations may include shipping pups to a facility where they could be housed with age mates or a suitable older foster parent wolf. Close communication with the USFWS Mexican Wolf Recovery Coordinator and MWSSP Coordinator is required throughout this process.

Information on parental care, hand-rearing, and cross-fostering can also be found in Chapter 4.

CHAPTER 10:
TRANSPORT AND SHIPPING

General:

Medical specimen records should always be sent in advance of a shipment and should also accompany the wolf during shipment. There should also be coordination between the two facilities' veterinary staff to determine which preshipment medical exams the receiving facility would like performed.

Local Transport:

For local transport to another pen, veterinary clinic, etc., the animal should be placed in a crate in a well-ventilated vehicle. Under no circumstances should a crated wolf be left for any period in direct sunlight or in areas where there is excessive noise and commotion. Adult wolves that have experience being crated will normally lie quietly in a crate while being transported. Young wolves that have not been crated may thrash around or periodically bite at the crate. This reaction can be reduced by loosely covering the crate with a light shade screen or tarp.

When transporting wolves in vehicles over long distances, animals should be transported in secured crates similar to those used for air transport. Equipment such as nets, noose, medical kit, cellular phone should be taken along in the event that problems arise. The vehicle should be well ventilated and the temperature monitored so that the wolves do not become over-heated or chilled. At no time should wolves be transported over long distances in the back of a pick-up truck. The maximum amount of time to consider transporting wolves over long distances should not exceed twenty-four hours. Wolves should never be crated the night before a scheduled transport (vehicle or air). If departures are anticipated when it is dark, the wolf should be moved to a smaller holding area to allow for easier crating.

Air or Long Distance Transport:

If the animal is to be transported over a great distance, it can be shipped by commercial air freight. Mexican gray wolves should not be sedated for a long distance shipment. If the animal should become ill while under sedation it may not be able to clear its throat of obstruction and should it try to stand without having a full sense of balance, it may fall and injure itself. Because of the hazard of motion sickness, animals should be fasted for at least twelve hours prior to shipment. Water should be provided up until the animal is crated for shipment.

Considerations when arranging animal shipments include ambient temperatures, length of time the animal is confined to the shipping crate, and the amount of extra handling

required by the airlines. Most commercial airlines have internal, as well as Federal, regulations that sufficiently address the welfare of the animal; however, facility personnel should still monitor the shipment and do everything possible to coordinate with the airlines. Due to the possibility of heat stress, it is recommended that animals be shipped during the cooler months of the year or at night during the summer months. (It is recommended to not ship wolves by air when the temperature is above 80^{o} because of heat stress.) Most airlines will not accept the animal shipment if air temperatures are excessive (generally above 84^{o}F or below 32^{o}F; 28.9^{o}C/0^{o}C) at any point where the animal will be on the ground. Whenever possible, non-stop flights should be scheduled between the shipping points. If a shipment requires a change of planes it means layover time for the animal with additional handling required by the airline, longer crate time for the wolf, and potentially undesirable holding areas (such as on the tarmac or within stuffy baggage carts). Although most airlines require a minimum of a two hour layover to guarantee transfer to the new plane it often can be longer—sometimes as much as six hours. For these reasons, layovers and indirect flights should be avoided if at all possible. Inter-airline transfers pose even larger problems since they require more coordination and there is also a risk of the animal missing its flight.

Shipper's Responsibility:

The airline will require that a reservation to ship the animal be made several days in advance. Once the shipping arrangements have been made and confirmed, the shipper, as a precaution, should contact each airline freight manager that will be involved in the shipment. The freight manager should be contacted to go over pertinent information on the nature of the animal and any special precautions such as avoiding heat (by keeping the animal's crate in a well-ventilated, shaded area during periods that it is on the ground). Shippers must always be alert to changes, and the fact that sometimes airline personnel may make a mistake and give out wrong information. A call to the airline, an hour before leaving for the airport, is advisable to confirm times and check for cancellations due to technical problems or weather conditions. Carriers may also place a ban on animal shipments to certain locations if the temperature is considered too risky, or during certain times of the year like Christmas and other holidays because cargo space is full from extra mail and packages. After the animal has departed, the shipping facility should contact the receiving facility to confirm that the shipment has been made and to inform them of any known changes in routing of the wolf.

Required Documents - Depending on the carrier or the receiving facility, paperwork required to accompany the animal may include, but not be limited to: two copies of a health certificate from the shipper's veterinarian stating the date of the animal's last rabies vaccination and that the animal is in good health (Figure 10-A); two copies of a USDA animal transfer form (Figure 10-B); health records of the animal; and an endangered species permit along with the shipper's USFWS Mexican Wolf Loan Agreement. Animal data transfer forms and Enrichment data transfer forms are available through the American Association of Zookeepers (Figures 10-C and 10-D), plus the animal's transponder number should also be included. The AAZK forms are available from aazkoffice@zk.kscoxmail.com or 1-800-242-4519 via Barbara Manspeaker.

Receiver's Responsibilities:

The receiver should call the airline to confirm that the animal made its connection, if the plane will be arriving on schedule or if the animal was loaded on an earlier flight etc. Appropriate arrangements should be made if there were changes to the original flight. After an animal has arrived and been transported to the receiving facility, the receiving facility should call the shipper to inform them that the animal arrived safely. It is standard procedure for the receiving facility to pay all shipping costs. Unless otherwise arranged shipping crates should also be returned promptly to the sender at the receiving facility's expense.

Transport Crate and Shipping Preparation:

Strict adherence by many airline carriers to IATA policies and in some cases outright refusal to ship a wolf has compounded shipping difficulties. Acceptable crates will vary according to airlines, the location (city) of the airline and even airline personnel accepting a wolf for shipment. The crate selected for shipping should be strong enough to withstand the rigors of shipping, enclosed to provide security for the animal, well ventilated, and just large enough for the animal to lie down, turn around, and stand. If a standard 500 size Vari-Kennel or its equivalent is used, modifications may be required to secure the animal inside. The doors and windows should be fortified with welded wire fabric, the door should be wired to the crate by way of pre-drilled holes through the plastic entrance, and burlap is fitted over the doors and windows to reduce stress on the animals during shipment. The shipper should confer with the airline to be certain that the dimensions of the crate selected meet their minimum requirements for the size of the animal, as well as any maximum size restrictions specific to the aircraft (Figure 10-E). In order to prevent urine or feces from spilling out of the crate into the aircraft and to keep the animal dry, airlines may require a bedding material to cover the bottom of the crate. In general, wood shavings are recommended as bedding. However, refer to USDA guidelines when shipping internationally, straw or certain other agricultural products may not be allowed into the destination country. Water and/or food containers in the crate are not recommended for shipping; wolves can and will chew the small plastic dishes supplied with the crates. Some airlines or individual personnel may argue the need for this based on USDA guidelines and/or their own airline policies. However, a letter from the facility's veterinarian stating that it is not recommended often alleviates delays or refusal to ship (Figure 10-F).

Clear instructions that USFWS personnel or cooperators would be made available to care for the wolf if the animal should be delayed helps to alleviate concerns (i.e. the airline isn't responsible for watering or feeding when a delay occurs). If the shipping facility has had difficulty with particular airlines strictly enforcing this policy refer to USDA Subpart F. Section 3.139(c), "A sufficient quantity of food and water shall accompany the live animal to provide food and water for such animal for a period of at least 24 hours, except as directed by hibernation, veterinary treatment, normal fasts, and other professionally accepted practices." If transport exceeds 24 hours, it is recommended that an attendant from the shipping facility accompany the wolf. We are always concerned about heat

stress with shipments; however, the airlines may also express concern regarding cold temperatures during our fall shipping season. These concerns can also be addressed through the Certificate of Acclimation (Figure 10-F). The crate must be clearly marked (Figure 10-G) with the shipper's name and address, the receiver's name and address, contact names and phone numbers for the shipper and receiver, the species name and indication that it is an endangered species. Most airlines also require upward arrows indicating right side up for the crate. Examples of institutional shipment and arrival check lists can be found in Figures 10-H and 10-I.

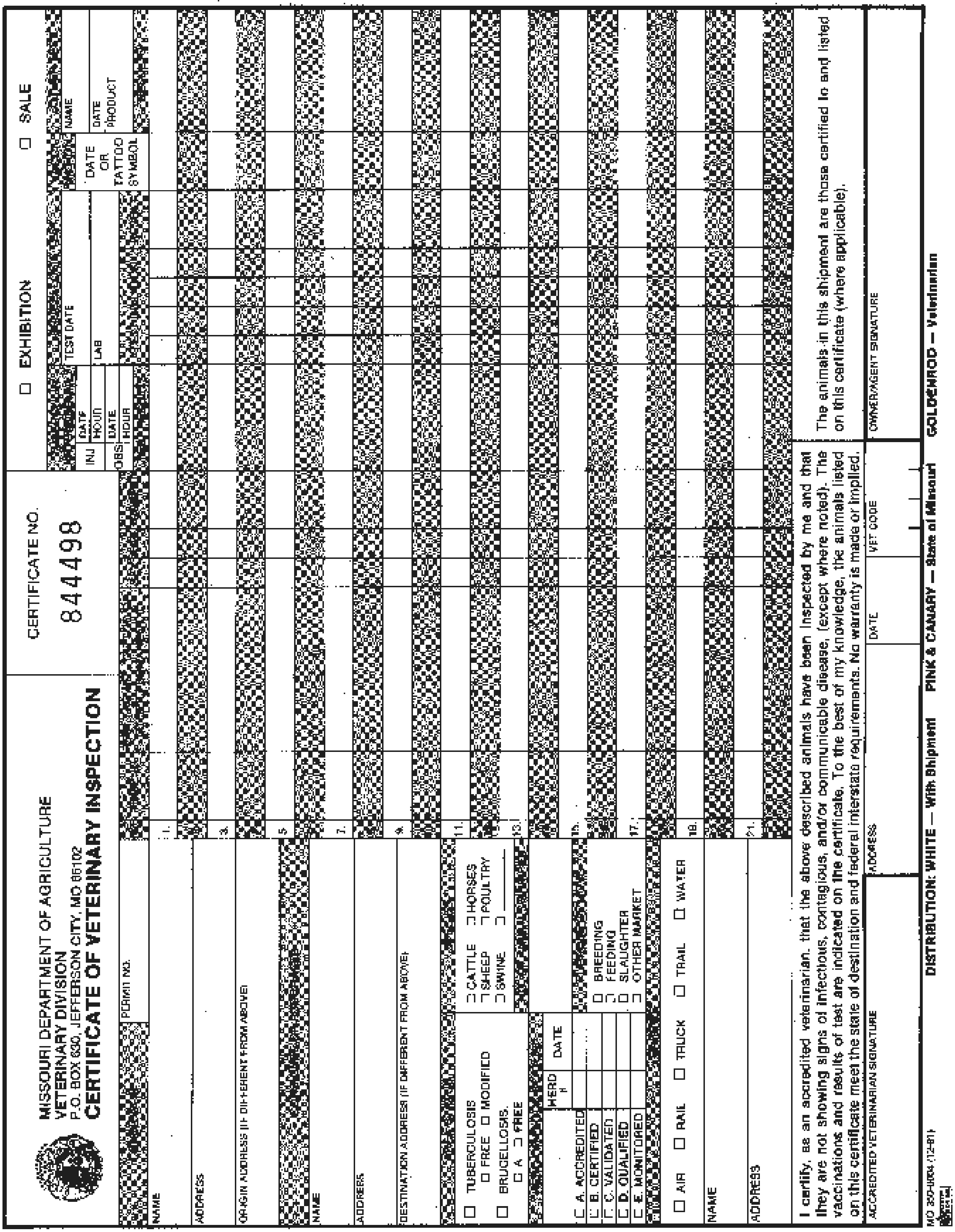
Transport between the United States and Mexico:
International shipment between countries obviously requires another level of preparation and coordination. Shipments involving animal transfer across the United States – Mexico border are generally designated at the summer meeting several months before an actual shipment is done; this time is frequently required in order to be certain that appropriate government paperwork is in order. Shipments have been coordinated to occur simultaneously at a border checkpoint but are also frequently executed solely by air travel. Institutions requested to be part of an international transport are urged to discuss with the US Fish and Wildlife Service advisor and SSP Coordinator requirements of the move and also use the expertise of other institutions which have been involved in recent shipments. An international shipment document check list can be found in Figure10-J.

References (Referencias):

Kent Newton. 1995. Mexican Wolf Husbandry Manual. Mexican Wolf SSP Management Group.

Will Waddell. 1998. Red Wolf Husbandry Guidelines for Captive Management. Red Wolf SSP Management Group.

Figure 10-A. Certificate of Veterinary Inspection (Health certificate).



MISSOURI DEPARTMENT OF AGRICULTURE
VETERINARY DIVISION
P.O. BOX 630, JEFFERSON CITY, MO 65102
CERTIFICATE OF VETERINARY INSPECTION

CERTIFICATE NO.
844498

☐ EXHIBITION ☐ SALE

INJ DATE / HOUR — OBS DATE / HOUR — TEST DATE — LAB — DATE OR TATTOO SYMBOL — NAME — DATE PRODUCT

PERMIT NO.

NAME

ADDRESS

ORIGIN ADDRESS (IF DIFFERENT FROM ABOVE)

NAME

ADDRESS

DESTINATION ADDRESS (IF DIFFERENT FROM ABOVE)

☐ TUBERCULOSIS ☐ FREE ☐ MODIFIED
☐ BRUCELLOSIS. ☐ A ☐ FREE

☐ CATTLE ☐ HORSES
☐ SHEEP ☐ POULTRY
☐ SWINE ☐ ________

	HERD #	DATE
☐ A. ACCREDITED		
☐ B. CERTIFIED		
☐ C. VALIDATED		
☐ D. QUALIFIED		
☐ E. MONITORED		

☐ BREEDING
☐ FEEDING
☐ SLAUGHTER
☐ OTHER MARKET

☐ AIR ☐ RAIL ☐ TRUCK ☐ TRAIL ☐ WATER

NAME

ADDRESS

1.
3.
5
7.
9.
11.
13.
15.
17.
19.
21.

I certify, as an accredited veterinarian, that the above described animals have been inspected by me and that they are not showing signs of infectious, contagious, and/or communicable disease, (except where noted). The vaccinations and results of test are indicated on the certificate. To the best of my knowledge, the animals listed on this certificate meet the state of destination and federal interstate requirements. No warranty is made or implied.

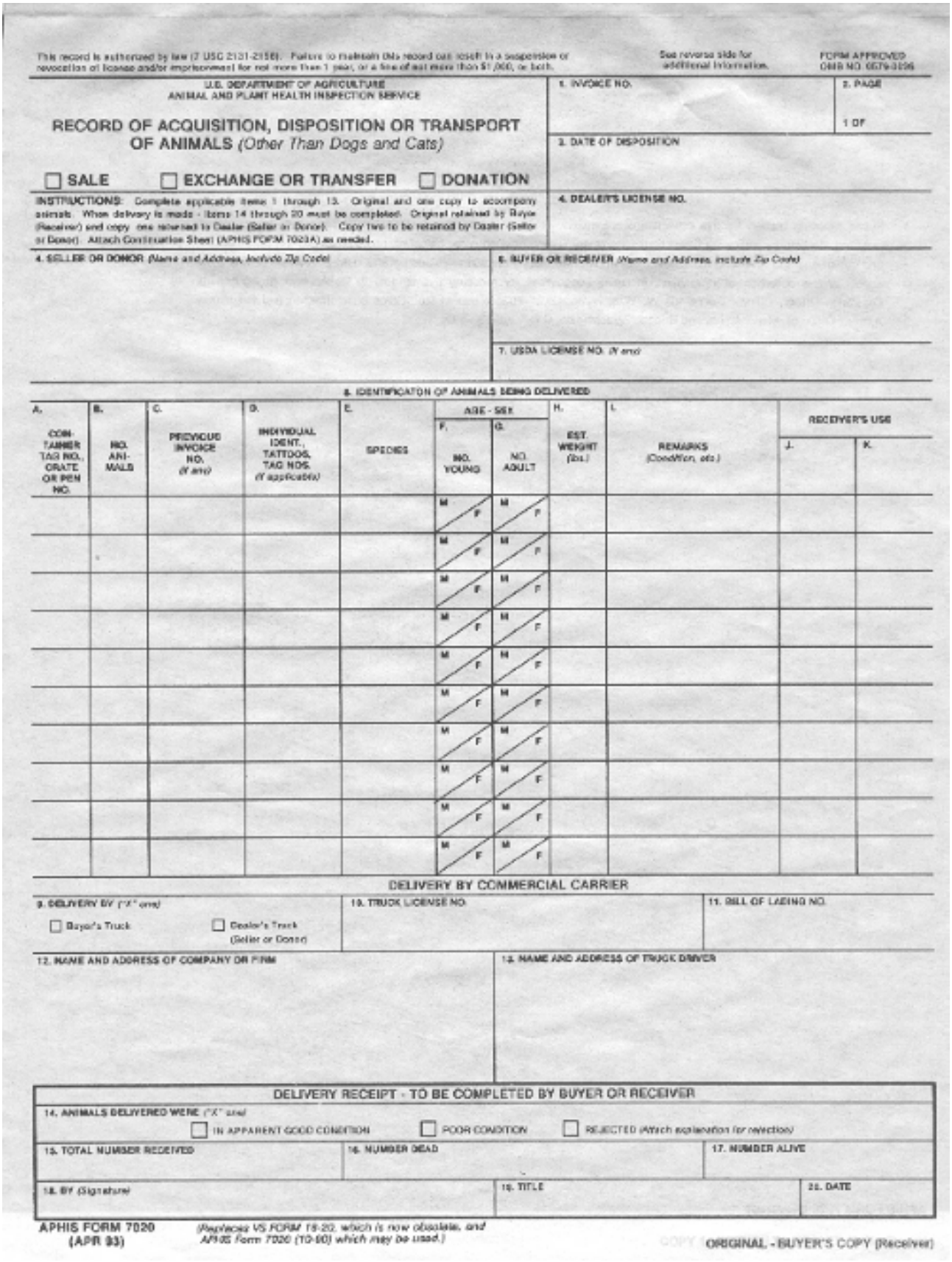
The animals in this shipment are those certified to and listed on this certificate (where applicable).

ACCREDITED VETERINARIAN SIGNATURE — ADDRESS — DATE — VET CODE — OWNER/AGENT SIGNATURE

MO 350-0004 (12-81)

DISTRIBUTION: WHITE — With Shipment PINK & CANARY — State of Missouri GOLDENROD — Veterinarian

Figure 10-B. USDA Animal Transfer Form.



This record is authorized by law (7 USC 2131-2159). Failure to maintain this record can result in a suspension or revocation of license and/or imprisonment for not more than 1 year, or a fine of not more than $1,000, or both. See reverse side for additional information. FORM APPROVED OMB NO. 0579-0036

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE

RECORD OF ACQUISITION, DISPOSITION OR TRANSPORT OF ANIMALS *(Other Than Dogs and Cats)*

☐ SALE ☐ EXCHANGE OR TRANSFER ☐ DONATION

1. INVOICE NO. | 2. PAGE 1 OF

3. DATE OF DISPOSITION

4. DEALER'S LICENSE NO.

INSTRUCTIONS: Complete applicable items 1 through 13. Original and one copy to accompany animals. When delivery is made - items 14 through 20 must be completed. Original retained by Buyer (Receiver) and copy one returned to Dealer (Seller or Donor). Copy two to be retained by Dealer (Seller or Donor). Attach Continuation Sheet (APHIS FORM 7023A) as needed.

4. SELLER OR DONOR *(Name and Address, Include Zip Code)*

5. BUYER OR RECEIVER *(Name and Address, Include Zip Code)*

7. USDA LICENSE NO. *(If any)*

8. IDENTIFICATION OF ANIMALS BEING DELIVERED

A. CONTAINER TAG NO., CRATE OR PEN NO.	B. NO. ANIMALS	C. PREVIOUS INVOICE NO. *(If any)*	D. INDIVIDUAL IDENT., TATTOOS, TAG NOS. *(If applicable)*	E. SPECIES	AGE - SEX F. NO. YOUNG	AGE - SEX G. NO. ADULT	H. EST. WEIGHT (lbs.)	I. REMARKS (Condition, etc.)	RECEIVER'S USE J.	RECEIVER'S USE K.
					M F	M F				
					M F	M F				
					M F	M F				
					M F	M F				
					M F	M F				
					M F	M F				
					M F	M F				
					M F	M F				
					M F	M F				
					M F	M F				

DELIVERY BY COMMERCIAL CARRIER

9. DELIVERY BY *("X" one)*
☐ Buyer's Truck ☐ Dealer's Truck (Seller or Donor)

10. TRUCK LICENSE NO.

11. BILL OF LADING NO.

12. NAME AND ADDRESS OF COMPANY OR FIRM

13. NAME AND ADDRESS OF TRUCK DRIVER

DELIVERY RECEIPT - TO BE COMPLETED BY BUYER OR RECEIVER

14. ANIMALS DELIVERED WERE *("X" one)*
☐ IN APPARENT GOOD CONDITION ☐ POOR CONDITION ☐ REJECTED *(Attach explanation for rejection)*

15. TOTAL NUMBER RECEIVED | 16. NUMBER DEAD | 17. NUMBER ALIVE

18. BY (Signature) | 19. TITLE | 20. DATE

APHIS FORM 7020 (APR 93)

(Replaces VS FORM 19-22, which is now obsolete, and APHIS Form 7020 (10-90) which may be used.)

COPY ORIGINAL - BUYER'S COPY (Receiver)

ANIMAL DATA TRANSFER FORM

1. Animal keepers' information on a new arrival.
2. Copy for keepers caring for this animal.
3. Copy for zoo files and/or veterinarian.

Figure 10-C

Date:_____

Common Name:_____ Scientific Name:_____

	Individual Name	Sex	Birth Date*	Weight*	Vendor Specimen# (ISIS#)	Zoo ID	Studbook #
1.							
2.							
3.							

*Note if it is actual or estimated

Diet: Present diet and supplements, favored items, problem foods, feeding procedures.

Brief Reproduction Record: Relative data, introduction techniques, behavior towards young, specific concerns.

General Medical History and Physical Conditions: Usual response to medicine, including immobilizing agents and their successful mode of administration, recurring physical problems and symptoms.

Enclosure, Maintenance Data: General exhibit description, cage mates, considerations to avoid abnormal behavior, cleaning and disinfecting procedures.

Sending Institution: Please indicate if option is desired. **Yes No**

Option: State condition of animal(s) upon arrival and return a copy of this form to the institution that shipped the animal(s).

Present Institution_____
Previous Institution_____
Future Institution_____
Form completed by _____Title_____
Telephone_____

ENRICHMENT DATA TRANSFER FORM

Figure 10-D

1. Quarantine keeper staff
2. Copy for keepers caring for this animal
3. Copy for zoo files and/or veterinarian

Date:_____

Institution_____ Telephone_____

Contact person_____ Fax/Email_____

Common name_____ **Scientific Name**_____

House name_____ **Sex**_____ **Age**_____ **ISIS #**_____

Behavioral History: Behavioral and medical problems, general behavior _____

_____

_____

Reactions to keepers (shy, likes males vs. females) _____

Stereotypic behavior: List _____ How frequent _____

How severe _____ Duration _____ Triggers _____ What helps _____

Other relevant information _____

_____

Trained Behaviors _____

How often _____ squeeze cage/chute _____

General Background Information: (Check or list all that apply)

Social – Housed alone_____ Housed w/same species (#)__

Housed with mixed species__ species housed with_____

Housed on exhibit_____ off-exhibit_____ access to both_____

Rearing type – mother_____ hand-reared_____ peer_____ family/social_____

Preferred enrichment for this animal_____

Enrichment offered: daily_____ weekly_____ monthly_____ scheduled_____

other_____

Naturalistic/Exhibit Enrichment: (When offered or provided, please list or check where applicable)

Static:

Substrates sand_____ gunite_____ mulch_____ leaf litter_____ soil

other_____

Plants/rotten logs/termite mounds/trees in enclosure_____

Streams/Ponds_____ Perches-artificial/natural_____

Is indoor area – holding___ exhibit___ natural looking___ concrete/chain-link has plants___ no indoors____

Rotating
Substrates: sand_____ mulch_____ leaf litter_____ soil_____ other

How often enrichment given_____

Perches-artificial/natural_____Plants/rotten logs_____

Olfactory_____Auditory_____

Other (snake sheds, hot rocks/cooling/misting, etc.)_____

_____

Food Enrichment: (variety, presentation, style, please list or check, includes diet and food enrichment)

# of feedings per day_____varied times_____ when_____ food scattered_____ hidden_____

Carcass foods (roadkill, hides, parts, feeder animals, bones)_____

Live foods_____ Diet varied - highly____ moderate_____ slightly not at all_____

Preferred foods_____ Diet – blended _____ dried _____ diced _____ whole cut _____

Browse (list types)_____

Browse offered: daily_____ weekly_____ monthly_____frozen_____ fresh_____

Other (rawhide, popsicles, blood trails, etc.)_____

_____

_____

Artificial Enrichment: (Check and list)

PVC feeders_____ Tires_____ Burlap/towels_____

Plastic containers_____ Puzzle feeder_____

Cardboard boxes/tubes/bags_____ Robes/vines_____

Balls/kegs/barrels_____ Toys (Kong®, dog chews, etc.)_____

Attachments used (chain, rope, bungee)_____ How often enrichment given _____

Other_____

_____

_____

Safety Concerns: (eats plastic or cardboard, items animals shouldn't have, bad experiences, failed items)_____

_____

Comments:_____

_____

_____

_____

_____

From IATA Live Animal Regulations, 285th Edition effective 1 October 2001

Note: These are the published IATA recommendations, but many airlines allow shipments in adapted Vari-Kennels. These kennels typically have the windows and doors covered with wire mesh and burlap (or some

CONTAINER REQUIREMENT 82

The illustrations shown in this Container Requirement are examples only. Containers that conform to the principle of written guidelines for the species but look slightly different will still meet the IATA standards.

Applicable to:

Aardwolf	Dhole	Jackal	Panda (lessor or red)
Badger species	Dog, bush wild	Jaguarundi	Tasmanian tiger
Bobcat	Dog, hunting wild	Lynx	Wild cat species (small)
Bush dog	Dog, fighting	Maned wolf	Wolf
Caracal	Fox species	Ocelot	Wolverine
Coyote	Hyaena species	Otter species	

See Variations GBG-05, HKG-01, SAG-02, USG-08 and other USG Variations in Chapter 2 and Variations AF-01, BA-04, Co-04/05/09, IB-01 and SV-01 in Chapter 3.

1. CONTAINER CONSTRUCTION

(*see Variation QF-01 in Chapter 3*)

Materials

Wood, metal, weld mesh and wire mesh.

Principles of Design

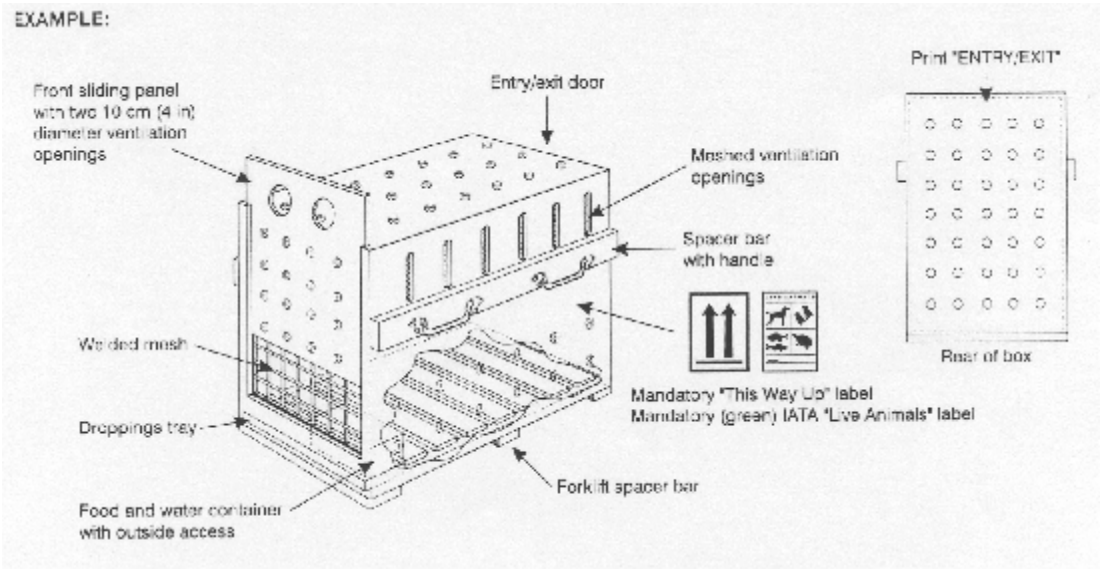
The following principles of design must be met in addition to the General Container Requirements outlined at the beginning of this chapter.

Dimension

The height of the container must allow the animal to stand in a natural position with its head extended and the width must permit it to turn around and lie down comfortably. The actual measurements will vary with the species involved.

Frame

The frame must be made from solid wood or metal parts bolted or screwed together. It must be constructed so that it cannot be damaged from continual biting or scratching at the corners. If the total weight of the container plus animal exceeds 60 kg (132 lb) metal bracing must be added to the frame.



Sides

The sides and door must be made of metal or solid wood. The front of the container must be constructed of weld mesh. The mesh must have a diameter that will prevent the animal protruding its nose or paws to the outside. The whole front must be covered by a sliding shutter which can be raised and lowered to permit feeding and watering. It must have two observation holes of at least 10 cm (4 inc) in the upper part and ventilation holes, with a minimum diameter of 2.5 cm (1 in), spread over the remainder of the surface in order to give good ventilation but at the same time leave the animal in semi-darkness.

Floor

The floor must be slatted, over a leak-proof droppings tray.

Roof

Must be solid wood or metal with ventilation openings over its surface.

Doors

A sliding door must be provided, it can be made from the weld meshed ventilation front if required. It must have a secure means of fastening so that it cannot be opened accidentally.

Ventilation

The main ventilation front must be supplemented by meshed openings along the upper part of the container walls and/or holes with a minimum diameter of 2.5 cm (1 in) spread over the top third of the sides and the whole of the back and top. These holes must be spaced both horizontally and vertically at intervals of approximately 10 cm (4 in) centre to centre. It is essential that there is some ventilation provided in the lower third of the sides for the removal of harmful waste gases.

The total ventilated area must be at least 20% of the total area of the surface of all four sides. More ventilation and the use of larger meshed openings is permitted but the animal must not be able to protrude its nose or paws to the outside from any opening.

If the mesh is fixed to the interior of the container all sharp edges must be protected.

Spacer Bars/Handles

Must be made to a depth of 2.5 cm (1 in), must be present on the sides of the container as shown in the illustration.

Feed and Water Containers

Food and water containers must be provided with a means of access from the outside.

Special Requirements

Hyena, wolves, badger, otter, wolverine and wild dogs, must have the container completely lined with sheet iron or other hard metal sheeting with through ventilation holes cut into it.

Palletized shipments must have the containers made entirely of weld mesh of a suitable dimension that no part of the animal can protrude in order to ensure good ventilation.

Forklift Spacers

Must be provided if the total weight of the container plus the animal exceeds 60 kg (132 lb).

Rigid Plastic Pet Containers
(*see Container Requirement 1*)
Some of the less destructive of these species can be transported individually in modified rigid plastic pet containers.

Animals over 25 kg (56 lb) are carried at the discretion of the carrier.

The following modifications must be made:

- the grill door must be covered with securely fixed weld mesh and all ventilation openings covered with wire mesh;
- the door of the larger containers must have secure fastenings at the top and the bottom;
- a curtain, that can be raised and lowered and does not impede ventilation, must be fixed over the door to reduce light inside the container;
- a dropping tray must be fixed to the floor and filled with absorbent material;
- there must be ventilation openings on the rear of the container, extra ventilation openings may have to be made in order that the total ventilation area is at least 20% of the four sides.;
- food and water containers must be fixed inside with access from the outside;
- the container must be correctly labeled.

If a container has wheels, they must be removed or rendered inoperable.

2. PREPARATIONS BEFORE DISPATCH
(*see Chapters 5 and 10*)

No special requirements.

3. FEEDING AND WATERING GUIDE
(*for emergency use only)*

Animals do not normally require additional feeding or watering during 24 hours following the time of dispatch.

If feeding is required due to an unforeseen delay, canned dog or cat food must be provided but care must be taken not to overfeed.

4. GENERAL CARE AND LOADING
(*see chapters 5 and 10)*

Animals in quarantine must be segregated from those which are not.

Hand-reared young may be loaded in the same container as long as they are used to cohabiting.

Figure 10-F

Certificate of Acclimation

Number of Animals:_____

Species:_____

The wolf contained in this crate/enclosure
is acclimated to air temperatures below
32° but not lower than 0° F.

Do not feed or water. Call for assistance
if animal is delayed (636) 938-6490.

Veterinarian Signature:_____

Date:_____

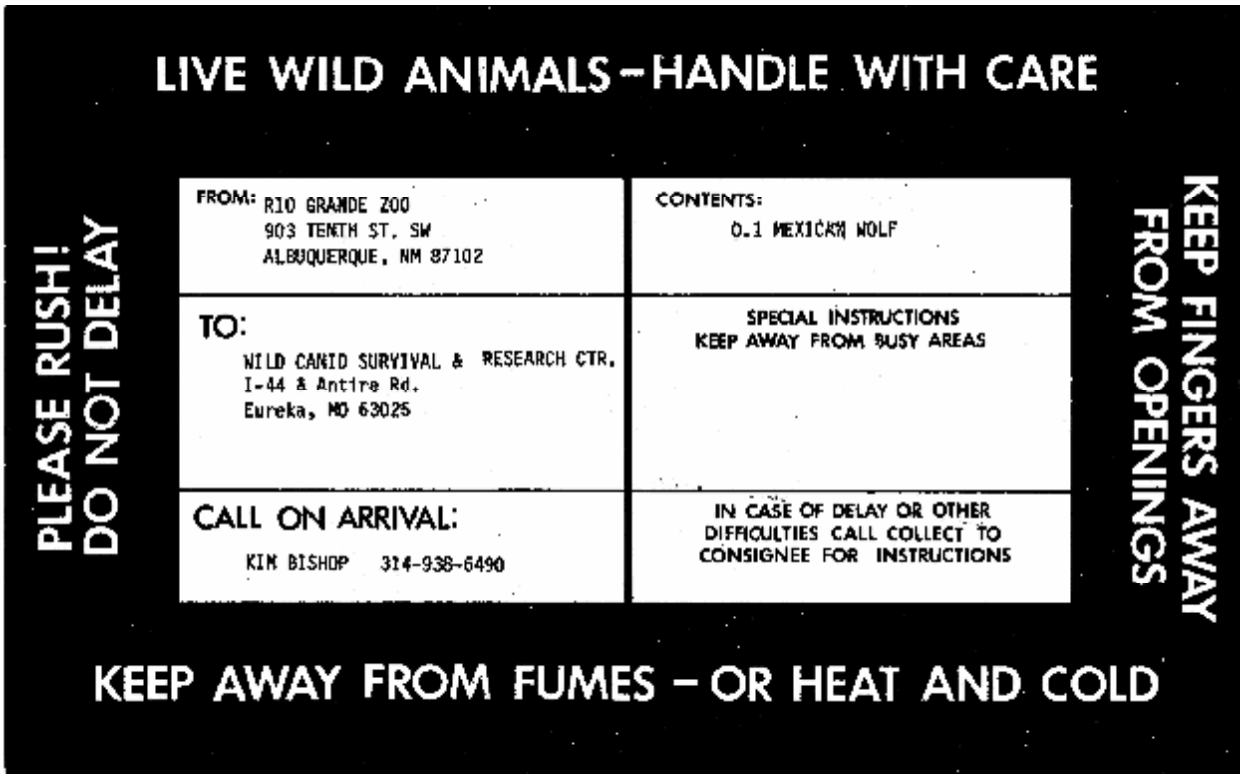


Figure 10-G
Example of crate label.

WOLF SHIPMENT CHECK LIST

Figure 10-H

Date of shipment:_____
House name and #:_____
Species:_____
Receiving Facility:_____

Initial as completed, form is to remain with animal's file.
Do not file away until all paper work has been returned and completed.

_____ Take away food by 5pm the night before shipment.
_____ Prepare crates for shipment:
_____name, address, and phone numbers of shipping facility
_____name, address, and phone numbers of receiving facility
_____live animal stickers
_____do not feed or water – see instructions inside message
_____designate animal's endangered status, species, and to observe caution while handling crate
_____bailing wire and metal rods to secure door
_____burlap pieces to cover door and windows
_____duct tape to secure burlap over windows and door
_____wood shavings in bottom of crate

_____ Paper work to accompany shipment:
_____ISIS transfer form
_____copy of animal's file
_____two copies of the health certificate (a copy and the original)
_____acclimation letter
_____AAZK animal data transfer form
_____AAZK enrichment data transfer form
_____USDA transfer form
_____take copy of WCSRC permits to airport – just in case

If receiving facility is new:
_____include copy of our permits
_____include copy of their permits

_____ Paper work after completion of shipment:
_____take out of ISIS
_____copy of USDA transfer form into animal's file
(if flying) _____copy of Airway bill in animal's file
_____original airway bill (stapled to USDA form) filed in USDA folder for inspector
_____pull original animal file from active and file in inactive

Date:
_____ Vari-kennel and/or other equipment returned from receiving institution.
_____ Receiving institution's <u>accession #</u> for transfer animal.
_____ Communicate transfer info to SSP Studbook Keeper including receiving institution's <u>accession #</u> for transfer animal.
_____ Signed USDA transfer form returned from receiving institution (file in USDA folder for inspector).

Figure 10-I

WOLF ARRIVAL CHECK LIST

Date of arrival:_____

Mode of Transport (flight#):_____

House name and #:_____

Species:_____

Shipping Facility:_____

Initial as completed – form is to remain with animal's file.
Do not file away until all paper work has been returned and completed

_____ Prepare enclosure or holding area:
_____food/water pans
_____shelter
_____locks
_____other:_____

_____ Paper work:
_____prepare file for active file
_____prepare copy of file for safe
_____copy of USDA transfer form in USDA file (with airbill if applicable)
_____enter new animal in ISIS
_____assign WCSRC accession #

_____ Paper work etc. sent back to facility:
_____mail back signed USDA transfer form
_____send copy of our ISIS report indicating our accession # for new animal
_____communicate transfer info to SSP Studbook Keeper including accession #
_____return equipment and/or shipping crate

Figure 10-J

INTERNATIONAL SHIPMENT CHECK LIST
Mexican gray wolves being shipped from United States to Mexico
(as of 12/2008)

US Shipper:

_____ USDA interstate/international certificate of health – APHIS form 7001

_____ APHIS form 720 – Record of Acquisition/Disposition/ or Transfer of Animals

_____ USFWS form 3-177 pre-cleared for where animal is being loaded

_____ General precautionary instructions regarding: feeding, watering, not opening crate

_____ Broker arrangements for where the wolf is entering

_____ Rabies certificate from the shipping institution's veterinarian

_____ Pro Forma Commercial Invoice

_____ US Customs North America Free Trade Agreement – Certificate of Origin (may not need but better to have this document than to have the wolf turned back at border)

Need to get from Mexico:

_____ CITES Import Permit

_____ Hoja de Requisitos Zoosanitarios (some information on this form needs to be transferred to the USDA form)

BIBLIOGRAPHY
2009

Allen, L.S. 1990. Habitat management for the Mexican wolf. 8pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

Ames, N. 1980. Mexican wolves in captivity: a review of the lineage originating in the 1960s at the Arizona-Sonora Desert Museum. Unpublished report. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 36pp.

Asa, C.S., K.L. Bauman, M. Callahan, J.E. Bauman, D.H. Volkmann, and W. Jöchle. 2006. Induction of fertile estrus with either natural mating or artificial insemination followed by birth of pups in gray wolves (*Canis lupus*). Theriogenology 66:1778-1782.

Asa, C., P. Miller, M. Agnew, J.A.R Rebolledo, S.L. Lindsey, M. Callahan, and K. Bauman. 2007. Relationship of inbreeding with sperm quality and reproductive success in Mexican gray wolves. Animal Conservation 10:326-331.

Bailey, V. 1931. Mammals of New Mexico. U.S. Department of Agriculture, Bureau of Biological Survey, Washington, D.C. North American Fauna No. 53:1-412.

Baker, R.H. and B. Villa-R. 1960. Distribucion geographica y poblacion actuales del lobo gris en Mexico. Anal. Inst. Biol. Univ. Nacional Mexico 30:369-374.

Bernal-Stoopen, J. 1989. Proyecto biológico para la recuperación del lobo mexicano (*Canis lupus baileyi*). Pages 175-207 *In* Memorias del VI Simposio sobre Fauna Silvestre. F.M.V.Z., U.N.A.M., Mexico, D.F.

_____ and J.M. Packard. 1997. Differences in winter activity, courtship, and social behavior of two captive family groups of Mexican wolf (*Canis lupus baileyi*). Zoo Biology 16(5): 435-443.

Bednarz, J.C. 1988. The Mexican wolf: biology, history, and prospects for reestablishment in New Mexico. Endangered Species Report 18. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 70pp.

_____. 1989. An evaluation of the ecological potential of White Sands Missile Range to support a reintroduced population of Mexican wolves. Endangered Species Report 19. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 96pp.

Biggs, J.R. 1988. Reintroduction of the Mexican wolf into New Mexico: an attitude survey. Masters thesis, New Mexico State University, Las Cruces, New Mexico. 66pp.

Bogan, M.A., and P. Melhop. 1983. Systematic relationships of gray wolves (*Canis lupus*) in southwestern North America. Occasional Papers of the Museum of Southwestern Biology, Univ. New Mexico, No.1. 21pp.

Bowdoin, J., R.J. Wiese, K. Willis, and M. Hutchins, eds. 1994. AZA annual report on conservation and science. American Association of Zoological Parks and Aquariums, Bethesda, Maryland. 375pp.

Brown, D. E., ed. 1983. The wolf in the southwest: the making of an endangered species. Univ. Arizona Press, Tucson, Arizona. 195pp.

_____. 1990. Comparing southwestern and Mediterranean wolves. 8pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

Brown, W. 1999. Mexican wolf reintroduction annual report I. Reporting period: January 1 – December 31, 1998. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 12pp.

_____. 2000. Mexican wolf reintroduction annual report I. Reporting period: January 1 – December 31, 1999. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 12pp.

_____. 2001. Mexican wolf reintroduction annual report I. Reporting period: January 1 – December 31, 2000. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 12pp.

Burbank, J. C. 1990. Vanishing lobo. Johnson Publishing Co., Boulder, Colorado. 208pp.

Carley, C.J. 1979. Narrative report on alleged Mexican gray wolf (*Canis lupus baileyi*) lineages held in captivity. Unpublished report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 6pp.

Carrera, J.A. 1990. Survival in Mexico today. 3pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

_____. 1995. Mexican wolf recovery program, annual report 1994. Unpublished report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 10pp.

Cerda-Ardura, A. 1992. Probabilities of extinction of the Mexican wolf (*Canis lupus baileyi*) and guidelines for its genetic and demographic management. Dissertation submitted to the Jersey Wildlife Preservation Trust and the University of Kent at Canterbury, England. 55pp.

_____, and F. Soberon-Mobarak. 1993. Analisis de la poblacion certificada de lobo

mexicano y lineamientos para su manejo genetico y demografico. 5pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____ and _____. 1993. Probabilidades de extincion del lobo mexicano mediante simulaciones de cambio estocastico. 7pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____ and _____. 1993. Estrategia general para la conservacion del potential evolutivo del lobo mexicano. 6pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

Cochran, C. 1990. A call for the wild: Mexican wolf slide show. 7pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

Crissey, S.D., K.D. Ange, K.A. Slifka, W. Sadler, S. Kahn and A.M. Ward. 2004. Serum lipid concentrations in six canid and four ursid species in zoos. Journal of Zoo and Wildlife Medicine 35(1): 34-39.

Defenders of Wildlife. 1994. Fact sheet - Wolf compensation fund. Defenders of Wildlife, Washington, D.C. 2pp.

Drag, M.D. 1991. Hematologic values for captive Mexican wolves. Am. Jour. Vet. Res. 52:1891-1892.

_____. 1995. Serum chemistry values for captive Mexican wolves. *In* L. Carbyn, S. Fritts and D. Seips, eds. Ecology and management of wolves in a changing world. Canadian Circumpolar Institute Occasional Publication No.35: 447-451.

Duffield, J., and C. Neher. 1994. Mexican wolf economic impacts. Contractor report by Bioeconomics, Missoula, Montana, to the U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 27pp.

Esquivel-Lacroix, C., Rivera-Rebolledo J.A., R.M. Paramo-Ramirez, G. Lopez-Islas, and F. Mata-Castro. 1993. Utilizacion de la citogia vaginal exfoliativa para el seguimiento del ciclo estral del lobo gris mexicano (*Canis lupus baileyi*), Parte II. 10pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____, J.A. Rivera-R., R.M. Paramo-R., G. Lopez-I., and E. Beatriz-A. 1993. Diagnostico de gestacion in lobo mexicano, *Canis lupus baileyi*, a traves de ultrasonido de tiempo real. 4pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM,

Mexico, D.F.

Fain, S.R., L.A. DeLisle, B.F. Taylor, J.P. LeMay, and P. Jarrell. 1995. Nuclear DNA fingerprint and mitochondrial DNA sequence variation in captive populations of Mexican gray wolves. Unpublished report. U.S. Fish and Wildlife Service, Albuquerque, NM.

Findley, J.S., A.H. Harris, D.E. Wilson, and C. Jones. 1975. Mammals of New Mexico. Univ. New Mexico Press, Albuquerque, New Mexico. 360pp.

Fredrickson, R. and P. Hedrick. 2002. Body size in endangered Mexican wolves: effects of inbreeding and cross-lineage matings. Animal Conservation 5:39-43.

Fredrickson, R., P. Siminski, M. Woolf, and P.W. Hedrick. 2007. Genetic rescue and inbreeding depression in Mexican wolves. Proceedings: Biological Sciences. 274. 7p.

García-Moreno, J., M.D. Matocq, M.S. Roy, E. Geffen, and R.K. Wayne. 1996. Relationships and genetic purity of the endangered Mexican wolf based on analysis of microsatellite loci. Conservation Biology 10:376-389.

Girmendonk, A.L. 1994a. Mexican wolf sighting reports in Arizona; 1983-1993. Unpublished report, Arizona Game and Fish Department, Phoenix, Arizona. 12pp.

_____. 1994b. Mexican wolf prey densities: Arizona management zone, primary zone and Coronado National Forest south of Interstate 10. Unpublished report. Arizona Game and Fish Department, Phoenix, Arizona. 16pp.

Gish, D.M. 1977. An historical look at the Mexican gray wolf (*Canis lupus baileyi*) in early Arizona Territory and since statehood. Unpublished report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 204pp.

Groebner, D.J., A.L. Girmendonk, and T.B. Johnson. 1995. A proposed cooperative reintroduction plan for the Mexican wolf in Arizona. Nongame and Endangered Wildlife Program Technical Report 56. Arizona Game and Fish Department, Phoenix, Arizona. 135pp.

Hall, E.R., and K.R. Kelson. 1959. The mammals of North America. The Ronald Press Co., New York, NY. Vol. I and II. 1083pp.

Harwell, G. 1984. The Mexican gray wolf (*Canis lupus baileyi*) studbook, 31 August 1982 to 1 November 1984. Arizona-Sonora Desert Museum, Tucson, Arizona. 8pp.

Harwell, G., J. Angell and R.E. Merideth. 1985. Chronic superficial keratitis in a Mexican wolf, *Canis lupus baileyi*. J. Am Vet Med Assoc 187(11): 1268.

Hedrick, P.W. 1995. Genetic evaluation of the three captive Mexican wolf lineages and consequent recommendations. Unpublished report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 23pp.

_____, P.S. Miller, E. Geffen and R. Wayne. 1997. Genetic evaluation of the three captive Mexican wolf lineages. Zoo Biology 16:47-69.

Hernandez, L., A. Lafon, and S. Gallina. 1985. Distributión actual de lobo mexicano (Canis lupus baileyi, Nelson y Goldman). Reporte Primera Etapa. Instituto de Ecología - SEDUE, Mexico City, D.F. 15pp.

Hernandez-A., R., C. Melendez-T., R. Molina-F., and F. Garza-S.. 1990. Evaluacion y recuperacion del habitat del lobo mexicano en el estado de Sonora. Unpublished report. Centro Ecologico de Sonora, Hermosillo, Sonora, 54pp.

Hoffmeister, D.F. 1986. Mammals of Arizona. Univ. Arizona Press and Arizona Game and Fish Department, Tucson, Arizona. 602pp.

Housholder, B. 1959. The wolf in Arizona, part I. Arizona Wildlife-Sportsman, October 1959.

_____. 1968. The wolf in Arizona. Private printing. 20pp.

Hubbard, J.P. 1994. Potential impacts of Mexican wolf reestablishment on indigenous, endangered wildlife in New Mexico. Unpublished report, New Mexico Department of Fish and Game, Santa Fe, New Mexico. 22pp.

Jenkins, P.T. 1993. Public scoping summary - Mexican wolf reintroduction. Unpublished report, U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 9pp.

Johnson, T.B. 1990. Preliminary results of a public opinion survey of Arizona residents and interest groups about the Mexican wolf. Unpublished report, Arizona Game and Fish Department, Phoenix, Arizona. 55pp.

_____. 1990. Habitat preferences of the Mexican wolf. 6pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

_____, D.M. Noel, and L.Z. Ward. 1992. Summary of information on four potential Mexican wolf reintroduction areas in Arizona. Nongame and Endangered Wildlife Program Technical Report. Arizona Game and Fish Department, Phoenix, Arizona. 88pp.

Kalinowski, S.T., P.W. Hedrick and P.S. Miller. 1999. No evidence for inbreeding

depression in Mexican and red wolf captive breeding programs. Conservation Biology 13(6):1371-1377.

Kawata, K. 1997. Return of el lobo: a recovery program coming of age. International Zoo News 10/11:1-14.

Kelly, B. M. Brown and O. Byers, eds. 2001. Mexican wolf reintroduction program three-year review workshop: final report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN. 130pp.

Kitchen, A.M. and F.F. Knowlton. 2006. Cross-fostering in coyotes: evaluation of a Potential conservation and research tool for canids. Biological Conservation 129: 221-225.

Leopold, A.S. 1959. Wildlife of Mexico: the game birds and mammals. Univ. of California Press, Berkeley, California. 568pp.

Lindsey, S. Lyndaker and D.P. Siminski. 2003, Return of the Mexican wolf – a binational success story. WAZA Magazine No.4:20-22.

Lindsey, S. Lyndaker and P. Siminski. 2007. Return of the Mexican wolf – a binational success story. Association of Zoos and Aquariums. Connect, January 2007:12-13.

López-Islas, G. 1993. Potential aporte genetico del L-SJA de lobo mexicano al programa de cria en cautiverio de *Canis lupus baileyi*. 7pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____. 1993. Actividades de la subcomision de manejo en cautiverio. 4pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____, and C.B. Vázquez-Gonzáles. 1993. Linaje de lobos mexicanos "San Juan de Aragon": historia, evidencias de su authenticidad y posibilidad de certificacion. 7pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

Manrique-Nobara, B., M.I. Reyna-Medrano, and G. Islas-Dondé.(moderadors) 1993. Conclusiones y recomendaciones del I Simposium Nacional sobre el lobo mexicano (*Canis lupus baileyi*). 6pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

Marinez-Meyer, E., A. Townsend Peterson, J.I. Servin and L.F. Kiff. 2006. Ecological niche modelling and prioritizing areas for species reintroductions. Oryx, 40(4), 411-418.

Maqueda-Amador, N.L., J.A. Rivera-Rebolledo, and R. Marroquín-Gonzáles. 1993. Manejo medico del lobo gris mexicano (*Canis lupus baileyi*) en el Zoologico San Juan de Aragon. 5pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

McBride, R.T. 1978. Status of the gray wolf (*Canis lupus baileyi*) in Mexico. Unpublished report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 72pp.

_____. 1980. The Mexican wolf (*Canis lupus baileyi*): a historical review and observations on its status and distribution. Endangered Species Report 8. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 38pp.

Mech, L.D. 1970. The wolf: the ecology and behavior of an endangered species. Natural History Press, Garden City, New York. 380pp.

Montero-Montero, E. 1993. Asociaciones civiles y el lobo mexicano en San Juan de Aragon, (1981-1993). 3pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

Navarrete-Estrada, F.J., J.R. Aquilar-García, F. Acevedo-Arteaga, M.de C. Donovarros-Aquilar, and I. Bronillet-Tarragó. 1993. Proyecto alternativo de recuperacion de la subespecie *Canis lupus baileyi* Goldman 1929 (lobo mexicano). 7pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

Nelson, E.W. and E.A. Goldman. 1929. A new wolf from Mexico. J. Mamm. 10:165-166.

Newton, K.A. 1990. Mexican wolf status in captivity. 7pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

_____. 1995. Mexican wolf husbandry manual. Unpublished report. Rio Grande Zoo, Albuquerque, New Mexico. 27pp.

Nowak, R.M. 1995. Another look at wolf taxonomy. *In* L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute Occasional Publication No.35:375-397.

Nunley, G.L. 1977. The Mexican gray wolf in New Mexico. Unpublished report, U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 80pp.

Packard, J. and J. Bernal-Stoopen. 2000. Mexican wolf. *In* Richard P. Reading and Brian

Miller, eds. Endangered Animals: A Reference Guide to Conflicting Issues. Greenwood Press, Westport, Connecticut. 383pp.

Parker, D. 1990. The Mexican wolf: a strategy for survival. 7pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

Parsons, D.R. 1993a. Draft proposed action for reintroduction of the Mexican wolf (*Canis lupus baileyi*). Unpublished report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 1993b. Comparison of habitat suitability attributes of five areas being considered for the reintroduction of Mexican wolves. Draft unpublished report, U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 8pp.

_____. 1994. Wild predation scenarios. Unpublished report.U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____, and J.E. Nicolopoulos. 1995. Status of the Mexican wolf recovery program in the United States. *In* L. Carbyn, S. Fritts and D. Seips, eds. Ecology and management of wolves in a changing world. Canadian Circumpolar Institute Occasional Publication No.35:141-146.

_____. 1996. Case study: the Mexican wolf. Pages 1001-123 *In* E.A. Herrera and L.F. Huenneke, eds. New Mexico's Natural Heritage: Biological Diversity in the Land of Enchantment. New Mexico Journal of Science, Volume 36.

Poglayen, I. 1980. The Mexican gray wolf (*Canis lupus baileyi*) studbook, 1973 to 2 June 1980. Arizona-Sonora Desert Museum, Tucson, Arizona. 3pp.

_____. 1981. The Mexican gray wolf (*Canis lupus baileyi*) studbook, 2 June 1980 to 1 September 1982. Arizona-Sonora Desert Museum, Tucson, Arizona. 4pp.

_____. 1982. The Mexican gray wolf (*Canis lupus baileyi*) studbook, 1 September 1981 to 31 August 1982. Arizona-Sonora Desert Museum, Tucson, Arizona. 5pp.

Povilitis, A., D. R. Parsons, M. J. Robinson, and C. D. Becker. 2006. The bureaucratically imperiled Mexican wolf. Conservation Biology 20(4):942-945.

Ramos-MagaJa, X., F. Mata-Castro, G. López-Islas, and G. Islas-Dondé. 1993. Lobo mexicano (*Canis lupus baileyi*) aspecto zootecnico en el Zoologico San Juan de Aragon. 6pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

Rangel-Rodriguez, I.C., L.A. Garcia-Camacho, and J.C. Valladares de la C. 1993. Valores hematicos en la poblacion de lobo gris mexicano (*Canis lupus baileyi*)

albergada en el Zoologico de San Juan de Aragon, reporte preliminar. 6pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____, L.A. Garcia-Camacho, and J.C. Valladares de la C. 1993. Perfil bioquimico en la poblacion de lobo gris mexicano (*Canis lupus baileyi*) existente en el Zoologico de San Juan de Aragon, reporte preliminar. 5pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

Resource Associates. 1997. Final public interaction needs assessment report. The Mexican wolf reintroduction program of the U.S. Fish and Wildlife Service-Region 2. Santa Fe, New Mexico. 28pp.

Reyes, J.M. and M.A. López. 1989. Estrategia para la recuperación del lobo mexicano (*Canis lupus baileyi*). Memorias del VI Simposio sobre Fauna Silvestre. F.M.V.Z., U.N.A.M., Mexico, D.F.

Rivera-Rebolledo, J.A., C. Esquivel-Lacroix, R.M. Paramo-Ramirez, G. Lopez-Islas, and C. Vasquez. 1993. Utilizacion de la citogia vaginal exfoliativa para el seguimiento del ciclo estral del lobo gris mexicano (*Canis lupus baileyi*), Parte I. 5pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____, L.Maqueda-Amador and R. Marroquin Gonzales. 1993. Manejo medico del lobo mexicano (*Canis lupus baileyi*) en el Zoologico San Juan de Aragon. 8pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____, G. Lopez-Islas, and C. Vasquez-G. 1993. Resupuesta conductuales de la manada de lobos mexicanos linaje registrado (*Canis lupus baileyi*) al nuevo alberque en el Zoologico San Juan de Aragon. 4pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

Russell, K.R. 1990. Some administrative responsibilities of the U.S. Fish and Wildlife Service for the Mexican wolf. 1pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

Schoenecker, K.A. and W.W. Shaw. 1997. Attitudes toward a proposed reintroduction of Mexican gray wolves in Arizona. Human Dimensions of Wildlife 2(3):42-55.

Scudday, J.F. 1972. Two recent records of gray wolves in West Texas. J. Mamm. 53:598.

_____. 1977. The Mexican gray wolf in Texas. Unpublished report, U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 16pp.

Seal, U.S. 1994. Draft report of Mexican wolf (*Canis lupus baileyi)* population viability assessment (PVA) workshop, 22-24 October 1990, at the Fossil Rim Wildlife Center, Texas. Unpublished report. IUCN/SSC/CBSG, Apple Valley, Minnesota. 86pp.

Servín-Martinez, J. 1983. Sobre el comportamiento reproductivo del lobo mexicano (*Canis lupus baileyi*). Memorias sobre el I Simposio sobre Fauna Silvestre. F.M.V.Z., U.N.A.M., Mexico, D.F.

_____. 1984. Interacciones agonístico de una manada de lobos (*Canis lupus baileyi*). Memorias del II Simposio sobre Fauna Silvestre. F.M.V.Z., U.N.A.M., Mexico, D.F.

_____. 1986. Estudio para la recuperacion del lobo mexicano (*Canis lupus baileyi*) en el Estado de Durango, II Etapa. Reporte Technico. Instituto de Ecologia - SEDUE, Mexico, D.F. 41pp.

_____. 1990. The Mexican wolf behavior y some ecological implications. 12pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

_____. 1991. Algunos aspectos de la conducta social del lobo mexicano (*Canis lupus baileyi*) en cautiverio. Acta Zool. Mex (n.s.). 45:1-43.

_____. 1993. El ethograma del lobo mexicano: resumen. 1pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____. 1993. La conducta social del lobo mexicano y algunas implicaciones ecologicas. 2pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____. 1993. Proyecto de investigacion del lobo mexicano en la reserva de la biosfera "La Michilia", Durango. 8pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

_____. 1993. Lobo...Estas ahi? Ciencias, No. 32:3-10.

_____. 1997. El periodo de apareamiento, nacimiento y crecimiento del lobo Mexicano (*Canis lupus baileyi*). Acta Zool. Mex. (n.s.) 71:45-56.

_____. 2000. Duration and frequency of chorus howling of the Mexican wolf (*Canis lupus baileyi*). Acta Zool. Mex. (n.s.) 80:223-231.

_____. 2004. La caceria como estrategia conductual para determiner el tamano de grupo del lobo Mexicano, CAP.38:451-464. In: Sanches-Cordero v. and Medellin R.A. (eds.) Contribuciones Mastozoologicas en Homenaje a Bernardo Villa, 500p. Instituto de Biologia e Instituto de Ecologia, UNAM, Mexico, 2004. ISBN 967-3422-44-9.

Servin, J., S. Lyndaker Lindsey, and B. A. Loiselle. 2001. Pileated woodpecker scavenges on a carcass in Missouri. Wilson Bull. 113(2):249-250.

Shields, W. M., A. Templeton, and S. Davis. 1987. Genetic assessment of the current captive breeding program for the Mexican wolf (*Canis lupus baileyi*). Contract report 516.6-73-13. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 20pp.

Siminski, D. P. 1985. The synoptic studbook for the Mexican gray wolf (*Canis lupus baileyi*), 31 October 1985. Arizona-Sonora Desert Museum, Tucson, Arizona. 5pp.

_____. 1986. The synoptic studbook for the Mexican gray wolf (*Canis lupus baileyi*), 31 October 1986. Arizona-Sonora Desert Museum, Tucson, Arizona. 6pp.

_____. 1987. The synoptic studbook for the Mexican gray wolf (*Canis lupus baileyi*), 31 December 1987. Arizona-Sonora Desert Museum, Tucson, Arizona. 7pp.

_____. 1988. The Mexican gray wolf international studbook, 1989. Arizona-Sonora Desert Museum, Tucson, Arizona. 11pp.

_____. 1989. The Mexican gray wolf international studbook, 1989. Arizona-Sonora Desert Museum, Tucson, Arizona. 12pp.

_____. 1990. The Mexican wolf recovery plan. 6pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter of the Wildlife Society, Tempe, Arizona.

_____. 1990. The Mexican gray wolf international studbook, 1990. Arizona-Sonora Desert Museum, Tucson, Arizona. 14pp.

_____. 1991. The Mexican wolf international studbook, 1991. Arizona-Sonora Desert Museum, Tucson, Arizona. 13pp.

_____. 1992. The Mexican wolf recovery effort. AAZPZ Reg. Conf. Proc.: 300-305.

_____. 1993. International Studbook for the Mexican gray wolf (*Canis lupus baileyi*), 1992. Arizona-Sonora Desert Museum, Tucson, Arizona. 24pp.

_____. 1993. The Mexican wolf recovery effort in the United States of America. 8pp.

In Memoria de 4° Congreso Latinoamericano de Parques Zoologico, Acuarios y Afines, ALPZA, AZCARM, Puebla, Puebla, Mexico.

_____. 1994. Mexican wolf international studbook: update from 1 January 1993 to 31 December 1993. Arizona-Sonora Desert Museum, Tucson, Arizona. 7pp.

_____. 1994. 1994 Mexican wolf SSP master plan. The American Zoo and Aquarium Association and Arizona-Sonora Desert Museum, Tucson, Arizona. 57pp.

_____. 1995. Mexican wolf international studbook: update from 1 January 1994 to 31 December 1994. Arizona-Sonora Desert Museum, Tucson, Arizona. 9pp.

_____. 1996. Mexican gray wolf international studbook, 1995. The Arizona-Sonora Desert Museum, Tucson, Arizona. 80pp.

_____. 1997. Mexican wolf international studbook: update from 1 January 1996 to 31 December 1996. Arizona-Sonora Desert Museum, Tucson, Arizona. 11pp.

_____. 1998. Mexican gray wolf international studbook: update from 1 January 1997 to 31 December 1997. Arizona-Sonora Desert Museum, Tucson, Arizona. 47pp.

_____. 1999. Mexican wolf international studbook, 1998. The Arizona-Sonora Desert Museum, Tucson, Arizona. 104pp.

_____. 2000. Mexican gray wolf international studbook: update from 1 January 1999 to 31 December 1999. Arizona-Sonora Desert Museum, Tucson, Arizona. 53pp.

_____. 2001. Mexican gray wolf international studbook: update from 1 January 2000 to 31 December 2000. Arizona-Sonora Desert Museum, Tucson, Arizona. 60pp.

_____. 2002. International studbook for the Mexican gray wolf. 20 November 2002. Arizona –Sonora Desert Museum. Tucson, Arizona. 125pp.

_____. 2004. Mexican gray wolf international studbook update: data current through 31 July 2004. Arizona-Sonora Desert Museum, Tucson, Arizona. 52pp.

_____. 2005. Mexican wolf, *Canis lupus baileyi*, international studbook. 29 July 2005. The Living Desert. Palm Desert, California. 125pp.

_____. 2006. Mexican wolf, *Canis lupus baileyi*, international studbook update, for the period 1 August 2005 through 31 July 2006. The Living Desert. Palm Desert, California. 43pp.

_____. 2007. Mexican wolf, *Canis lupus baileyi*, international studbook update for the period 1 Aug 2006 through 31 July 2007. The Living Desert. Palm Desert, California. 48pp.

_____. 2008. Mexican wolf, *Canis lupus baileyi*, international studbook update, 31 July 2008. The Living Desert. Palm Desert, California. 89pp.

_____ and E. Spevak. 2001. Breeding and transfer plan: Mexican wolf Species Survival Plan. American Zoo and Aquarium Association. 19pp.

_____ and E. Spevak. 2002. Breeding and transfer plan: Mexican wolf Species Survival Plan. American Zoo and Aquarium Association. 20pp.

_____ and E. Spevak. 2003. Population analysis and breeding plan: Mexican wolf (*Canis lupus baileyi*) Species Survival Plan. 31 July – 1 August 2003. American Zoo and Aquarium Association. 59pp.

_____ and E. Spevak. 2004. Population analysis and breeding plan: Mexican wolf (*Canis lupus baileyi*) Species Survival Plan. 29-30 July 2004. American Zoo and Aquarium Association. 62pp.

_____ and E. Spevak. 2005. Population analysis and breeding plan: Mexican wolf (*Canis lupus baileyi*) Species Survival Plan. 28-29 July 2005. American Zoo and Aquarium Association. 83pp.

_____ and E. Spevak. 2006. Population analysis and breeding plan: Mexican wolf (*Canis lupus baileyi*) Species Survival Plan. 27-28 July 2006. Association of Zoos and Aquariums. 76pp.

_____ and E. Spevak. 2007. Population analysis and breeding plan: Mexican wolf (*Canis lupus baileyi*) Species Survival Plan. 26-27 July 2007. Association of Zoos and Aquariums. 75pp.

_____ and E. Spevak. 2008. Population analysis and breeding plan: Mexican wolf (*Canis lupus baileyi*) Species Survival Plan. 24-25 July 2008. Association of Zoos and Aquariums. 77pp.

Sloan, M. 1990. Captivity or freedom for the Mexican wolf. 5pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

Spicer, R.B. 1990. Public attitudes toward wolves in Arizona today. 7pp. *In* Proc. Arizona Wolf Symposium '90, P.A.W.S. and AZ chapter The Wildlife Society, Tempe, Arizona.

Swaringen, K., R.J. Wiese, K. Willis, and M. Hutchins. 1995. AZA annual report on conservation and science. American Association of Zoological Parks and Aquariums, Bethesda, Maryland. 437pp.

Thompson, B. 2001. Mexican gray wolf recovery program interagency management

advisory group (IMAG) review. New Mexico Cooperative Fish and Wildlife Research Unit, Las Cruces, NM.

Thompson, B.C., J.S. Prior-Magee, M.L. Munson-Mcgee, W. Brown, D. Parsons and L. Moore. 1999. Beyond release: incorporating diverse publics in setting research priorities for the Mexican wolf recovery program. Trans. 65th North American Wildlife and Natural Resources Conference.278-291.

Townsend, S.E. 1997. The role of an audience in marking and caching in captive wolves, *Canis lupus lycaon* and *Canis lupus baileyi*. Advances in Ethology 32:268.

Trevi Ɔo-Fernández, J.C. 1993. El lobo mexicano: su futuro incierto. 7pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

USFWS. 1982. Mexican wolf recovery plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 115pp.

_____. 1984. Recommendations pertinent to releases of Mexican wolves. Unpublished report, U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 1p.

_____. 1988. The Mexican Wolf: Biology, History, and Prospects for Reestablishment in New Mexico. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Endangered Species Report.

_____. 1991. Proposal and general plan for an experimental release of the Mexican wolf (*Canis lupus baileyi*). U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

_____. 1992. Notice of intent to prepare an environmental impact statement on the experimental reintroduction of Mexican wolves (*Canis lupus baileyi*) into suitable habitat within the historic range of the subspecies. Federal Register vol.57, No.76:144427-144431.

_____. 1995. Reintroduction of the Mexican wolf within its historic range in the southwestern United States: draft environmental impact statement. U.S. Fish and Wildlife Service, U.S.D.I. Albuquerque, New Mexico.

_____. 1996. Reintroduction of the Mexican wolf within its historic range in the southwestern United States: final environmental impact statement. U.S. Fish and Wildlife Service, U.S.D.I. Albuquerque, New Mexico. 133pp.

_____. 1997. Notice of record of decision and statement of findings on the environmental impact statement on reintroduction of the Mexican gray wolf to its historic range in the southwestern United States. Albuquerque, NM.

_____. 1998. Mexican wolf interagency management plan. U.S. Fish and Wildlife Service. Albuquerque, NM

Vásquez-Gonzáles, C.B., and G. López-Islas. 1995. L-SJA Catalog: Mexican wolf San Juan de Aragon lineage (L-SJA). Unpublished report. Zoologico de San Juan de Aragon, Mexico, D.F. 9pp.

Villa-R., B. 1960. Combate contra lobos y coyotes en el norte de Mexico: sus repercuciones en la salubridad, en la economía y en la conservación de la fauna silvestre. Instrucciones para el uso del 1080. Ana. Inst. Biol. U.N.A.M. 61:463-499.

Wayne, R.K., N. Lehman, M.W. Allard, and R.L. Honeycutt. 1992. Mitochondrial DNA variability of the gray wolf: genetic consequences of population decline and habitat fragmentation. Conservation Biology 6:559-569.

Weber-Rodríguez, M. 1989. La pureza racial del lobo gris mexicano Canis lupus baileyi en cautiverio en Mexico: estudio preliminares. Memorias del VI Simposio sobre Fauna Silvestre. F.M.V.Z., U.N.A.M., Mexico, D.F. pp. 237-257.

_____. 1993. El Parque Nacional Big Bend y la Sierra del Carmen, como las mejores alternativas para ensayos de reintroduccion del lobo mexicano. 6pp. *In* Memorias Primer Simposium Nacional sobre el Lobo Gris Mexicano. Zoológico de San Juan de Aragón, INE, DDF, UNAM, Mexico, D.F.

Wells, D.L. and M. G. Hepper. 2006. Prenatal olfactory learning in the domestic dog. Animal Behaviour 72: 681-686.

Wolok, M. 1994. Reported wolf observations in New Mexico, Texas and Mexico. Unpublished report, U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 10pp.

Young, S. and E. Goldman. 1944. The wolves of North America. Volume I and II. American Wildlife Institute. Washington, D.C. 636pp.

Zia Research Associates. 1990. Executive report on 1989 New Mexico licensed deer hunter's survey. Unpublished report, New Mexico Fish and Game Department, Santa Fe, New Mexico. 280pp. [Note: contains survey results concerning public attitude to Mexican wolf reintroduction].

APPENDICES

Table of Contents:

Appendix A. From *International Zoo News* Vol. 44, No. 5 (1997), pp. 259-270

RETURN OF *EL LOBO*: A RECOVERY PROGRAM COMING OF AGE

by KEN KAWATA

Glory, fear and genocide

For unknown millennia, humans have been fascinated and intrigued by wild animals. Particularly, large carnivorous species have mystified us because of their strength and predatory habits. The legend of their mythical power survives today. On one hand we have glorified and admired some of them. Eagles are considered majestic lords of the air, and portrayed as national emblems. The lion, with its dignified and noble face, has been known as the King of the Beasts. On the other hand, some animals have evoked fear and hatred. One such example is the gray wolf (*Canis lupus*), which has loomed sinisterly in our consciousness, immortalized by the story of Little Red Riding Hood. This attitude is in ironical and nagging contrast to our relationship with another species in the genus, *C. familiaris*, 'man's best friend'.

In North America, native peoples coexisted with wolves. With the arrival of European colonists, the web connecting man with nature began to be torn, and the fate of wolves was sealed. America's wholesale destruction of wolves has been ably chronicled by McIntyre (1995). The heritage of coexistence with the natural world was alien to the colonists. In their livestock husbandry practice, few animals were fenced in or closely supervised, making them vulnerable to predation. In 1630, the Massachusetts Bay Colony instituted a wolf bounty. Soon other colonies followed suit, applying various measures to exterminate wolves. Destruction of predators became a national heritage, passed on from one generation to another.

The final phase of the war began in the 1880s. As the vast herds of bison, elk and deer were exterminated in the West, many wolf packs had no choice but to turn to their only remaining source of food, cattle and sheep. The war continued into the present century – in 1914 Congress appropriated $125,000 to launch the Predator and Rodent Control (PARC) program of the U.S. Biological Survey (USBS), predecessor of the U.S. Fish and Wildlife Service (FWS). 'No method was too cruel – wolves were shot, trapped, poisoned, clubbed, burned alive in their dens and even hunt' (Parent, 1990).

From 1915 to 1970 a total of 69,786 wolves, both gray and red (*C. rufus*), were killed by USBS/FWS and their cooperators. This figure does not include wolves that were killed by the U.S. Forest Service or the National Park Service, or wolves poisoned but never found. By the 1950s, the wolf population in its historic range in the U.S., except Alaska, had dropped from two million to just a few hundred. Few of us would oppose livestock owners' right to defend their animals, and to kill 'problem' wolves. However, as McIntyre put it (1995), 'Where we went wrong was to go beyond killing just problem wolves.' It was a genocidal campaign, instead of a predator management program.

The campaign has had other supporters. Some sports hunters assume that wolves might deplete their target herbivores. Leopold (1966) commented: 'One of the most insidious invasions of wilderness is via predator control. It works thus: wolves and lions are cleared out of a wilderness area in the interest of big-game management. The big-game herds (usually deer or elk) then increase to the point of overbrowsing the range. Hunters must then be encouraged to harvest the surplus, but modern hunters refuse to operate far from a car; hence a road must be built to provide access to the surplus game. Again and again, wilderness areas have been split by this process, but it still continues.' [Lion here refers to puma (*Felis concolor*); elk means wapiti (*Cervus elaphus*).]

It was in the 1940s that this essay was first published. Decades have passed, yet his words still hold true today. And it is hard to believe that Leopold, the pioneer conservationist, was once a supporter of predator control. Interestingly, Leopold proposed that wolves be brought back to their former home in Yellowstone National Park (McIntyre, 1995). Half a century later, his suggestion was to become reality.

Clouds over the Rocky Mountains

The age of absolute extermination has now passed, and wolves are returning, drifting across from Canada into the northern Midwest and Western states. Coincidentally, in the era of awakening ecological concern, FWS has experienced a role reversal, from exterminator to conservationist. When the Service conceived a plan to reintroduce gray wolves to the Yellowstone National Park in Montana and Wyoming, and to central Idaho, it was met with howls of protest. Not surprisingly, U.S. senators from all three states succeeded in blocking reintroduction efforts during the 1980s (Mitchell, 1994).

Against the livestock industry and politicians stood the environmentalists, and emotions, not facts, controlled the Yellowstone wolf debate. 'Because of the passion and politics involved, it is easy to oversimplify this debate. Just as unrealistic as the ranchers' scare tactics are the claims by certain environmentalists that wolves are sweet and docile animals; that the wolf is the ultimate symbol of harmony; and that everything noble, wise and courageous is somehow embodied in this one creature.' (Askins, 1995) Squeezed between these two camps were the biologists. 'Wolf biologists get beat up pretty bad in this business,' commented one of them (quoted by Mitchell, 1994); 'We have to deal with hysterical people at both ends.'

Greece, Italy and Spain, which are smaller and have higher human population densities than the United States, still retain wild wolves, although their methods of livestock husbandry may differ considerably from ours. People in these nations may wonder why the U.S., a larger and wealthier nation, cannot accept wolves. North of the border in Canada, Alberta has 5,000 wolves, and averages about one stock killing per year for every 93 wolves. British Columbia has 6,300 wolves and estimates livestock losses at about $60,000 per year (Bowden, 1992). Within the U.S., in Minnesota, a Midwestern state, 1,700 wolves live among 7,000 farms. On the average, only 29 of those farms suffer confirmed livestock losses to wolves annually (Mitchell, 1994). Regarding reintroduced animals, in the four years since red wolves (*C. rufus*) were reintroduced in Great Smoky Mountains National Park in the south-eastern U.S., they killed only 22 calves (Savage, 1995).

From: *International Zoo News* Vol. 44, No. 5 (1997), pp. 259-270

Although wolves seem to prefer more traditional prey over livestock, this fact seems not to influence the opposition to reintroduction. The outrage over this issue in the Rockies possibly stems, at least partially, from the regionality of the West. Under a cloud of controversy, Canadian wolves were released in central Idaho and Yellowstone National Park in 1995. Actually, the recovery efforts for the gray wolf had their roots in a time before this success story came into the picture, originating in a region some 1,000 km south of the Yellowstone.

Wolves in the cowboy country

The Mexican wolf, *C. l. baileyi*, locally referred to as the 'lobo', is the southernmost subspecies of the North American gray wolf, and once ranged over portions of central and northern Mexico, western Texas, southern New Mexico and southeastern and central Arizona. It is also the smallest subspecies. Its average weight and size are known only from carcasses: males averaged 25-34 kg and females 22-25 kg, and adults ranged from 1.4 to 1.7 m in total length. Confusion and disagreement persist over North American wolf taxonomy; two other subspecies, *mogollonensis* and *monstrabilis*, were described in the Southwest beside *baileyi*. FWS concurs with the theory that considers *baileyi* to include the above two subspecies (Parsons *et al.*, 1995).

Long before the coming of the Spanish explorers, the Mexican wolf lived in harmony with the land and the native peoples. For nearly four hundred years, European cattle raisers in the region managed to live with the wolf. All that would change during the late 1800s, when a campaign to eradicate wolves was initiated by ranchers and supported by federal, state and local governments (McIntyre, 1995). It is a familiar story; the program against a predator eventually takes on the emotional overtone of a crusade, as people are taught to abhor and fear the animal. The classic battle between ranchers and Mexican wolves was vividly documented by Seton in his story 'Lobo, the King of Currumpaw', which contains 'almost no deviation from the truth.' Lobo lived in the Currumpaw region of New Mexico from 1889 to 1894; he died on 31 January of that year (Seton, 1911). According to McIntyre (1995), the hide of this wolf is on display in a glass case in the Ernest Thompson Seton Memorial Library and Museum near Cimarron, New Mexico.

Mexican wolves were never numerous in their natural range. In more than 60 years of efforts at extirpation, PARC records show that only about 600 wolves were killed in Arizona, New Mexico, and western Texas, compared to about 24,000 in Colorado, Wyoming and Montana. The breeding populations of this subspecies were practically eliminated around 1926, only 11 years after the federal government entered the effort on the public land of the Southwest (Johnson, 1991). Records show that the last wolf was killed in Arizona in 1966, and in Texas and New Mexico in 1970. FWS added the wolf to the endangered species list in 1976.

Stories of wolf sighting persist on both sides of the border. However, since 1980 there has been no authenticated record of *baileyi* in the wild. Searches in northwestern Chihuahua, Mexico, and within the U.S. portion of the historic range have not confirmed the presence of any remnant populations (Lindsey, 1995). Surveys conducted by Mexican scientists in 1994-1996 have turned up occasional tantalizing possibilities, including recorded wolf-like howls, scats, tracks, and depredation records. However, no confirming evidence has been found. FWS conducted extensive surveys throughout

From: *International Zoo News* Vol. 44, No. 5 (1997), pp. 259-270

historic Mexican wolf range in the U.S. during 1995-1996, and failed to document the presence of wolves.

Recovery efforts begin

Captive populations of Mexican wolves began before an official conservation program got off the ground. In 1959, a male was trapped in Tumacacori, Arizona. A female was purchased as a pup in 1961 by a Canadian tourist in Yecora, Sonora, Mexico. These animals founded the Ghost Ranch lineage, named after a facility in Abiquiu, New Mexico. Another captive group, representing the Aragón lineage, originated at the Chapultepec Zoo in Mexico City in the mid-1970s. Because of the questions regarding their ancestry, these two lineages were kept separate from the Certified lineage, the third and largest population.

Under an agreement between the U.S.A. and Mexico, efforts to capture wolves in Mexico were initiated in 1977. A contract was issued to Roy McBride of Alpine, Texas, and he captured four males and one pregnant female between 1977 and 1980 in Durango and Chihuahua. The capture represented the last-ditch effort to rescue the lobo. These wolves became the nucleus of the Certified lineage, which was later renamed the McBride lineage. They were transferred to the Arizona-Sonora Desert Museum in Tucson, Arizona (Parsons *et al*., 1995). The application for an international studbook for this subspecies by Dr. Inge Poglayen was approved by AAZPA, IUCN and IUDZG in 1979, and she published the first edition in 1980 (P. Siminski, pers. comm.).

The decline of the Mexican wolf had already alerted certain individuals and groups in the 1960s. In February 1979, FWS sponsored a workshop at the Arizona-Sonora Desert Museum to discuss a recovery program (Ames, 1983). In September of that year in Albuquerque, New Mexico, the Mexican Wolf Recovery Team held its first meeting under the leadership of Norma Ames, New Mexico Department of Game and Fish. The Team, appointed by FWS, formulated plans and recommended action for saving this subspecies from extinction and re-establishing it in the wild (Meritt, 1979). The Team prepared the Mexican Wolf Recovery Plan, which was approved and signed by the director of FWS and the Director General of the Dirección General de la Fauna Silvestre (Mexico) on 15 September 1982.

The key objectives of this plan were to maintain a captive-breeding program, and to re-establish a viable wild population (FWS, 1982). From the beginning, zoos have played a vital role in the recovery efforts (e.g. Siminski, 1992). Until 1985, the Recovery Team advised FWS on the management of the captive population. In that year, a consortium of holders, the Mexican Wolf Captive Management Committee, was established, and the Committee met annually to formulate recommendations to FWS. While offspring from the Certified lineage were dispersed in zoos, the administration of the recovery program itself was inching at a snail's pace. In the absence of the full backing of political leaders, it was difficult for the FWS official to implement the recovery program. Stumbling blocks abounded, including the lack of funds, as well as the public relations problem created by the perceived reputation of wolves (reviewed by Bowden, 1992, Johnson, 1991 and Savage, 1995).

For four years after approval of the Recovery Plan in 1982, nothing happened to move the project forward. Captive breeding was halted in 1983, as the number of pups

overwhelmed the small number of holding facilities. Early in 1986, partly as a result of the alert from Defenders of Wildlife, a conservation group, some 400 letters in support of the Mexican wolf arrived at the FWS office in Albuquerque. For a while the project seemed to come to life, as FWS asked three states in the historic range of the subspecies to propose areas for future release. However, this led to more debates and controversies, and things went downhill rapidly. The final blow came in 1987. One of the proposed release sites was the White Sands Missile Range in New Mexico. The missile range was chosen primarily because no cattle graze in this area. In May of that year Major General Joe Owens, new commandant of the range, stated: 'We do not want wolves on the White Sands Missile Range.' As he withdrew permission for any wolf release, the controversy over wolves entered a new stage.

In response to the situation, New Mexico conservationists founded the Mexican Wolf Coalition; another group, Preserve Arizona's Wolves (P.A.W.S.), was formed in Arizona; and the Mexican Wolf Coalition of Texas was born. In April 1990, the New Mexico Coalition and other wolf advocates sued the Department of the Interior (which includes FWS under its jurisdiction) and the Department of Defense (which oversees the U.S. Army) for failing to fulfill their obligation under the Endangered Species Act to recover this endangered subspecies. Meantime, FWS disbanded the original Recovery Team and appointed a new team in 1991.

The lawsuit was instrumental in getting the program back on track. Within months David R. Parsons was appointed the full-time Recovery Coordinator. The appointment made history in Mexican wolf conservation. According to U.S. Senator Pete Domenici (pers. comm., 1991), 'the military has agreed to allow White Sands Missile Range to be included as one of a number of sites to be studied for the introduction of the wolf.' However, FWS still lacked sufficient funds for the Southwestern endangered species program. For instance, of the $1,156,000 allocated in fiscal year 1990 for endangered species recovery in the region, Congress earmarked near 46% for whooping crane and sea turtle programs. After subtraction for another $407,000 for salaries, only $218,000 was left for over 100 other endangered and threatened species.

After negative public opinion had thwarted government efforts to reintroduce controversial species into the wild, Congress struck a compromise on the Endangered Species Act. The product was 'experimental/nonessential classification', a 1982 amendment that is less stringent and allows the protection of the experimental population to be specifically tailored to local circumstances. The Mexican wolf recovery was to adopt this modified strategy. When fully implemented, the reintroduction was to cost between $400,000 and $600,000 annually as of 1991. Release sites were being examined carefully, as well as post-release management actions. The key to the success of the recovery was the production of healthy animals in captivity who were surplus to the captive population (Parsons, 1991).

In *Of Wolves and Men*, Lopez (1978) stated, without giving any specific details, that 'wolves in captivity represent pure strains of extinct races and therefore constitute a genetic reservoir, that is probably meaningless. Zoo populations are sometimes derived from animals of questionable genetic background and/or geographic origin, and in many cases subspecific labels are casually applied. And pups raised in captivity are virtually certain not to survive in the wild.' He continued, again with no data to substantiate his

charges, that 'wolves in zoos waste away,' and 'wolves kept in zoos die every year as a result of poor cage design, faulty capture systems, and harassment.'

If Lopez were to write a similar volume today, one wonders whether or not he would make the same charges. The successful red wolf recovery program has utilized zoo-born animals (e.g. Waddell, 1996). Captive-breeding efforts, with zoos in both the U.S.A. and Mexico participating, have contributed significantly to the recovery programs of the red wolf and the lobo. Specifically, a handful of lesser-known, smaller zoos must be given credit for supporting the Mexican wolf. In the U.S., those institutions are in the historic range of the subspecies, with the exception of the Wild Canid Survival and Research Center, popularly known as the Wolf Sanctuary, located outside of St. Louis, Missouri. Away from the mainstream of the AAZPA (now AZA), they maintained the captive populations during lean years. The Mexican wolf captive-breeding efforts have been a low-keyed program. With the exception of the Arizona-Sonora Desert Museum and Rio Grande Zoo in Albuquerque, none was an AZA-accredited institution. The roster included: Alameda Park Zoo (which later became AZA-accredited), Ghost Ranch Living Museum, Living Desert State Park, Hillcrest Park Zoo, all in New Mexico, and Navajo Nation Zoological and Botanical Park, Arizona.

Turning point: molecular biology helping lobo

In October 1990, a Mexican wolf PHVA was held in Fossil Rim Wildlife Center in Glen Rose, Texas, under the guidance of CBSG chairman Dr. Ulie Seal. During this meeting, it was disclosed that in spite of the small number of founders, heterozygosity in the Certified lineage was very high. The highlight was the presentation by Dr. Robert Wayne of the University of California at Los Angeles. He found unique gene alleles (variants) in *baileyi* not found in any other gray wolf subspecies in North America, indicating isolated evolutionary development over millennia. According to this young scientist, the Mexican wolf is the most distinct subspecies of North American gray wolf, and may be a relict form remaining from an early invasion of wolf-like canids that had crossed into North America over the Bering land bridge from the Old World. The PHVA marked a turning point for the lobo. In May of the following year, IUCN announced that its Wolf Specialist Group considered the Mexican wolf recovery the highest priority need for wolf conservation the world over. The Group, chaired by Dr. David Mech, urged FWS to follow through with recovery efforts in the light of recent research identifying the Mexican wolf's unique genetic makeup (Anon., 1991 a).

On the Mexican side, *baileyi* is among the top five priorities for management attention within the Terrestrial Wildlife Department of Mexico's federal wildlife agency, Secretaría de Desarrollo Urbano y Ecología (SEDUE), which has a captive propagation program (Siminski, 1992). On the U.S. side, a petition was filed to include the Mexican wolf in the Species Survival Plan (SSP). However, as of April 1992, AAZPA's position was that 'the SSP program is not to be taken to the subspecific level' (B. Read's memo to Siminski, 1992). But *baileyi* was no longer 'just another subspecies'. Its uniqueness seemed to have opened the door, and in December 1993 approval was given for a Mexican Wolf SSP. At this time, the Mexican Wolf Captive Management Committee was replaced by the SSP Management Group.

As of August 1989, the Certified lineage maintained a total of 37 animals, 29 in six facilities in the U.S.A. and eight in four facilities in Mexico. By 1995, the Certified

lineage population hit the three-digit mark with 107 wolves. The genetic goal set in 1994 projected the need for a carrying capacity of 240 wolves, and preserving 75% of the gene diversity in captivity for 50 years. However, one of the challenges facing the captive management has been the limited number of founders. Since recruitment from the wild was out of the question, the only way to increase the number of founders was to bring in the two uncertified lineages. But there remained the lingering genetic question. In 1988, FWS tentatively rejected the inclusion of the Ghost Ranch lineage in the U.S. breeding program, because of uncertainty about its paternal lineage.

Then, in 1995, came the big boost. A team of genetic experts determined that the Ghost Ranch and Aragón lineages are pure *baileyi*, bringing the number in the increased population to 139 animals prior to the 1996 breeding season (Brown, 1996). Further, the molecular data show that the Certified (McBride) lineage has three founders, instead of four as previously assumed. The biologists recommended that the three lineages be combined to increase the number of founders, and to postpone any inbreeding depression. This brings up the number of founders to seven, with two added from each of the previously uncertified lineages (Hedrick *et al*., 1997). As of the summer of 1996, there were 149 animals in 30 institutions. Another piece of good news in the mid-1990s was the increased number of participating zoos. In particular, the arrival of some 'élite' zoos helped to strengthen the program. The Bronx Zoo received a pair in September 1994; soon Lincoln Park Zoo, Chicago, and Minnesota Zoo, among others, followed the trend.

Meantime, a plan was being made for the eventual release of zoo-born wolves into the wild, patterned after the red wolf program. It requires re-establishment of a viable, self-sustaining population of at least 100 wolves in the middle to high elevations of an 8,000 km^2 area within the historic range of the subspecies by about the year 2005 (Parsons *et al*., 1995). The plan calls for wolves to be reintroduced into the Apache National Forest in Arizona and allowed to disperse throughout the adjacent Gila National Forest in New Mexico. The entire area is called the Blue Range Wolf Recovery Area. A second area, the White Sands Missile Range area, will be used only if it is feasible and necessary to achieve the recovery objective of 100 wolves (see map). The FWS projects that the Blue Range can support about 100 wolves. Beginning in 1998, three to five family groups of captive-reared wolves will be released annually for approximately five years, or until natural reproduction is adequate to sustain the population. Wolves and their offspring will be classified as a 'nonessential experimental population' to allow greater management flexibility (FWS, 1996).

Growth through struggles

The Endangered Species Act requires FWS not just to stem the loss of individual species, but also to work toward recovering viable populations in their natural surroundings. Between 1991 and 1996, in the Southwestern region, FWS conducted 24 public meetings to provide information and allow public comment and discussion. Overall, the mostly urban areas turned out in large numbers in favor of reintroduction, while just the reverse was true in the rural areas (Holaday, 1995). Regrettably, public support does not translate into political support.

'It is my hope that we can somehow find a way to prevent the extinction of this endangered species,' said U.S. Senator Domenici (pers. comm.). Ann Richards, then governor of Texas, commented, 'I support the reintroduction of endangered species of

wildlife, such as the Mexican wolf, to Texas, so long as it is done in a manner that does not endanger other species of wildlife and does not harm the livelihood of residents of areas where the potential exists for a new habitat' (Anon., 1991 b). Unfortunately, these voices represent the rarest of examples. The governors of Arizona and New Mexico have publicly opposed reintroduction, and they are supported by a powerful segment of their constituencies.

The livestock industry in the West is declining economically. Yet, it still dominates the rural economy, and retains a power political stronghold. Defenders of Wildlife established the Wolf Compensation Fund in 1987, to reimburse ranchers for verified livestock losses to wolves. To help reduce animosity toward the wolf, Defenders extended the program to the Southwest (Savage, 1995). Grass roots support for the Mexican wolf reintroduction is high. However, it will be doomed to failure if the very people who live in the region do not want wolves. Within the livestock industry, there is a tendency to regard the wolf issue as largely 'romantic' (e.g. Dale, 1995). Such a simplistic view overlooks reasons for re-establishment. One is the restoration of the ecosystem by bringing back the top predator, an irreplaceable biological resource. Another is to accept the wolf as the world's heritage for all future generations. McIntyre (1995) recalls a touching episode he witnessed at a small zoo in New Mexico. A Hispanic family approached a Mexican wolf exhibit. A young girl, perhaps ten years old, spotted one of the wolves and said excitedly, 'It's a Mexican wolf! He's part of my heritage!' Aside from anthropocentric view points, there also exists the thought that nature should be saved for the sake of nature itself.

For sure, within the livestock industry there are varying opinions. For instance, the Arizona Cattle Growers' Association passed a resolution opposing reintroduction of wolves in 1986. Five years later, the Association passed a resolution supporting the reintroduction (Dale, 1992). The industry does not necessarily present a monolithic front. However, in general, residents in this region traditionally tend to view the federal government with profound suspicion and skepticism. Sometimes the atmosphere at public 'open house' meetings was thick enough to slice. However, people were heard, and FWS was able to make positive changes in the final plan largely in response to comments received. The issue extends far beyond the realm of biology; what is at stake is the question as to who will control the land.

Bowden (1992) asserted: 'The Mexican wolf is not a biological problem. Nor a true land problem. With the wolf, we dip into the potent waters of human emotions, those parts of our being we can feel but not always recognize or name.' Too often we become prisoners of our own emotion, and fail to peer through the haze of emotions and note that wolves must be recognized for what they are, not what we would want them to be. It was five years ago that Bowden observed: '…a fight over where the wolf release should take place, or if it should take place at all, has dragged on and on and now involves three states (Arizona, New Mexico, and Texas), a fistful of state and federal wildlife agencies, pro-wolf coalitions, and anti-wolf ranchers' and cattlemen's associations, and has generated bushels of papers with analyses, charges, and countercharges.' Five years have not changed the political landscape fundamentally, to alter the tide of the anti-wolf force.

As for the captivity program, one major problem has been holding space limitations. Some zoos prefer big, furry, white and 'flashy' subspecies, such as

hudsonicus, for public appeal. The challenge facing the SSP is that of how to persuade zoo officials to provide space for more meaningful conservation programs. After all, *baileyi* appears to exist only in captivity. It is said that this is one of the rarest land mammals in the world (FWS, 1996; Savage, 1995), and on that account alone, deserves more attention in the zoo field.

In spite of its biological significance, the Mexican wolf generated little press coverage in comparison to the highly publicized Rockies wolf program, except in the Southwest. In my survey there were at least 106 articles, editorials and comments in three newspapers in New Mexico between 6 January 1993 and 12 June 1996. Around the same period, there were 35 similar accounts in five newspapers in Texas. It began to change in December 1996, when articles on the lobo appeared in *USA Today, BBC Wildlife Magazine* and the New York Times (Kanamine, 1996; Owen, 1996, Zaslowsky, 1996). In spite of increased attention, problems still remain. Congress voted to cut fiscal year 1996 spending on efforts to rescue endangered and threatened species. On the brighter side, 1996 also saw the construction of FWS's captive wolf management facility at Sevilleta National Wildlife Refuge near Socorro, New Mexico. In November and December, ten (5.5) wolves arrived here from eight zoos, including one in Mexico, to be prepared for release into the wild.

Despite difficulties, captive breeding has brought the lobo back from the brink of extinction to a point where it is now feasible to be re-established in the wild. On 4 March 1997, Secretary of Interior Bruce Babbitt, who oversees FWS and is himself a former rancher and governor of Arizona, signed a document to give the Mexican wolf a chance to reclaim its turf. With Mr. Babbitt's approval, the lobo has taken yet another step toward the return to the wild.

Epilogue

Seton's 'King of Currumpaw' first introduced me to the Mexican wolf. It was in post-war Japan, a devastated, poor nation, and the fate of wolves left a lasting impression in a teenager's heart. Little did I know that decades later and half-way around the world, I was to participate in a conservation program for this animal. Over the years, my wife and I toured the U.S. side of the historic range of the lobo. It is a familiar backdrop in cowboy films – an arid landscape consisting of sweeping vistas with barren flats, colorful geological formations and sharp-edged hills. The rugged and stark beauty of vast expanses, interspersed with mesas and canyons, is often overwhelming. Somewhat ironically, it is the rugged individualism of the American West that continues to refuse the lobo.

Robert Redford, the movie actor, asserted (Anon., 1991 c): 'We have made the entire planet ours. Can't we afford to give back a little to the wolf?' Conflicts between man and wolf ultimately boil down to competition for land. Lobo must return. It will represent a process of reconciliation with nature; it will also represent the beginning of healing. However, the possibility of lobo's successful return now hinges on a thin edge; it depends on whether or not the conservationists can gain enough strength in the political arena.

Acknowledgements

The author wishes to thank Wendy Brown, Mexican Wolf Recovery Biologist, U.S. Fish and Wildlife Service, Albuquerque, and Peter Siminski, Mexican Wolf SSP Coordinator and International Studbook Keeper, for critically reviewing the manuscript.

References

Ames, N. (1983): The Mexican Wolf Recovery Program and AAZPA. *AAZPA 1983 Regional Proceedings*, pp. 259-265.

Anon. (1991 a): IUCN makes Mexican wolf number one priority. *Mexican Wolf Recovery Newsletter* 2:2, p.1

Anon. (1991 b): Texas Governor Ann Richards: 'You have my full support.' *Mexican Wolf Recovery Newsletter* 2:2, p.2

Anon. (1991 c): Momentum builds. *Mexican Wolf Recovery Newsletter* 2:1, p. 1.

Askins, R. (1995): Releasing wolves from symbolism (Congressional Testimony). *Harper's Magazine* (April), pp. 16-17.

Bowden, C. (1992): Lonesome Lobo. *Wildlife Conservation* (Jan.-Feb.), pp. 45-73.

Brown, W. (1996): Mexican gray wolves – back to the wild? *Canid, Hyena and Aardwolf TAG Newsletter (CHAT)* 1:1, pp. 2-3.

Dale, D. (1992): Chances with wolves. *Beef* (Feb.), pp. 88-89.

Hedrick, P.H., Miller, P.S., Geffen, E., and Wayne, R. (1997): Genetic evaluation of the three captive Mexican wolf lineages. *Zoo Biology* 16:1, 47-69.

Holaday, B. (1995): Open houses and hearings on Mexican wolf reintroduction. *Wolf Sanctuary Review* (Fall), pp. 9-14.

Johnson, A.S. (1991): Will Lobo come home? *Defenders* (Jan.-Feb.), pp. 10-17.

Kanamine, L. (1996): Second chance for rarest wolf. *USA Today* (20 Dec.).

Leopold, A. (1996): *A Sand County Almanac*. Ballantine books, New York.

Lindsey, S. (1995): Mexican wolf update. *The Wolf Sanctuary Review* (Spring), pp. 4-5.

Lopez, B.H. (1978): *Of Wolves and Men*. C. Scribner's Sons, New York.

McIntyre, R. (1995): *War Against Wolf*. Voyager Press, Stillwater, Minnesota.

Meritt, D. (1979): Mexican Wolf Recovery Team meeting held. *AAZPA Newsletter* (Dec.), p. 26.

Mitchell, J. (1994): Uncle Sam's undeclared war against wildlife. *Wildlife Conservation* (Sept.-Oct.), pp. 19-31

Owen, J. (1996): El Lobo roams again. *BBC Wildlife Magazine* (Dec.), p. 61.

Parent, L. (1990): Last of the gray wolves. *Texas Park and Wildlife* (May), pp. 12-13.

Parsons, D.R., and Nicholopoulos, J.E. (1995): *Status of the Mexican Wolf* (Canis lupus baileyi) *Recovery Program in the United States*. U.S. Fish and Wildlife Service, Albuquerque.

Savage, H. (1995): Waiting for El Lobo. *Defenders* (Fall), pp. 8-15.

Seton, E.T. (1911): 'Lobo, the King of Currumpaw,' in *Wild Animals I Have Known*. C. Scribner's Sons, New York.

Siminski, D.P. (1992): The Mexican wolf recovery effort. *AAZPA 1992 Regional Proceedings*, pp. 300-307.

U.S. Fish and Wildlife Service (1996): *Reintroduction of the Mexican Wolf within its Historic Range in the Southwestern United States: Summary of Final Environmental Impact Statement.* FWS, Albuquerque.

Waddell, W. (1996): Species Survival Plan profile: Red wolves. *Endangered Species Update* Vol. 13, Nos 10/11, pp. 10-11.

Zaslowsky, D. (1996): Quietly, in isolated off-limits area, rarest of wolves is being groomed for return to the southwest wild. *New York Times* (17 Dec.).

Click on the link below for Appendix B – Mexican Gray Wolf *Restoration in the Southwest*
U.S. Fish & Wildlife Service Pamphlet

"Appendix B.pdf"

Appendix C.

FACILITIES CURRENTLY PARTICIPATING IN THE MEXICAN GRAY WOLF SPECIES SURVIVAL PLAN©

MEXICAN FACILITIES

CAYETANO
Reserva "San Cayetano"
Dirección General de Vida Silvestre (DGVS), SEMARNAT
Av. Revolución #1425 Nivel 1
Col. Tlacopac San Angel
Delegacion Alvaro Obregón C.P. 01040
México, D.F. MEXICO
PH: (+52-55) 56 24 33 09 / 56 24 36 65
FX: (+52-55) 56 24 36 42
Contact: Fernando Cortes or Martin Vargas Prieto
Email: fernando.cortes@semarnat.gob.mx , martin.vargas@semarnat.gob.mx

GUADALJR
Zoológico de Guadalajara
Paseo Del Zoológico #600
Huentitán El Alto
44100 Guadalajara, Jalisco
PH: (+52-33) 36 74 44 88 / 36 74 42 32
FX: (+52-33) 36 74 38 48
Director: MVZ. Francisco Rodríguez Herrejó Email: frodriguez@zooguadalajara.com.mx
Technical Contact: M.V.Z. Pablo Varela Martínez Negrete Email: pvarela@zooguadalajar.com.mx
Mexican Wolf Contact: M.V.Z. José Luis Rodríguez Avila Email: jrodriguez@zooguadalajar.com.mx

JU ARAGON
Zoológico de San Juan de Aragón
Dirección General de Zoológico de la Ciudad de México
Av. Chivatito s/n
1a. Sección del Bosque de Chapultepec
Col. San Miguel Chapultepec
11850 México, D.F.
PH: (+52-55) 55 53 62 63
FX: (+52-55) 55 53 62 63 ext. 2005
Director General: Dr. Jose Bernal Stoopen Email: josebernalstoopen@yahoo.com
Director: Dr. Juan Gonzales Romero Email: romerogonzalesjuan@yahoo.com.mx

LA MESA
Rancho "La Mesa"
Organización Vida Silvestre, A.C. (OVIS)
Business address: Ave. Roble 660. Col.
Valle de Campestre, San Pedro Garza
Garcia, Nuevo León 66265 Mexico.
PH: 011 52 81 8863 1564
PH: (+52-81) 88 63 12 60 / 88 63 13 27
FX: (+52-81) 88 63 13 41
Director: M.V.Z. Sergio Jiménez Lezma Email: SJimenez@ovis.org.mx
Mexican Wolf Contact: Cecilia Hernandez Email: chernandez@ovis.org.mx

LEON
Zoológico de León
Apartado Postal 7-89
37271 León, Guanajuato
PH: (+52-477) 764 32 41 / 764 43 14
FX: (+52-477) 764 32 42
Director: M.V.Z. Ángel Ordaz Santos Email: director@zooleon.org
Curator: Richard Sheffield Email: curador@zooleon.org
Mexican Wolf Contact: Dr. Ivon Ruiz Email: iruiz@zooleon.org

LOS ENCIN
Rancho "Los Encinos"
Ave. Zarco #2401
Fracc. Zarco
31020 Chihuahua, Chihuahua
PH: (+52-) 14 18 62 62
FX: (+52-)
Director: Alberto Lafon Terrazas Email: alafon@vach.mx

LOSCOYOTE
Zoológico "Los Coyotes"
Dirección General de Zoológicos de la Ciudad de México
Av. Chivatito s/n
1a. Sección del Bosque de Chapultepec
Col. San Miguel Chapultepec
11850 México, D.F.
PH: (+52-55) 55 53 62 63
FX: (+52-55) 55 53 62 63 ext. 2005
Director General: Dr. Jose Bernal Stoopen Email: josebernalstoopen@yahoo.com
Mexican Wolf Contact: Xóchitl Ramos Magaña Email: xramoslupus@hotmail.com

MEXICOCTY
Zoológico "Alfonso L. Herrera" del Bosque de Chapultepec
Dirección General de Zoologicos de la Ciudad de Mexico
Av. Chivatito s/n
1a Sección del Bosque de Chapultepec
Col. San Miguel Chapultepec
11859 México, D.F.
PH: (+52-55) 55 53 62 63
FX: (+52-55) 55 53 62 63 ext. 2005
Director General: Dr. Jose Bernal Stoopen Email: josebernalstoopen@yahoo.com
Mexican Wolf Contact: Xóchitl Ramos Magaña Email: xramoslupus@hotmail.com

MICHILIA
Reserva "La Michilia"
Instituto de Ecología, A.C.
Apartado Postal 632,
34000 Durango, Durango
Contact:

MONTERREY
Parque Zoológico "La Pastora"
Av. Pablo Vilma y E. Cavazos
Guadalupe, Nuevo Leon
Director: M.V.Z. Judith Tallabs Salazar Email: tallabsju@hotmail.com
PH: (+52-81) 83 37 13 88

FX: (+52-81) 83 37 43 40 y 50

NETZAHUAL
Parque Zoológico del Pueblo
San Sabastian y San Garcia
Ciudad Netzahualcoyotl
Estado de Mexico
Contact: same as TOLUCA

PUEBLA
Africam Safari
11 Oriente 2407
Col. Azcárate
72007 Puebla, Puebla
PH: (+52-222) 281 70 00 ext 240
FX: (+52-222) 281 70 00 ext 257
Director: Sra. Amy L. Camacho Email: dirgeneral@africamsafari.com.mx
Technical Contact: Frank Carlos Camacho Wardle Email: fcamacho@africamsafari.com.mx
Mexican Wolf Contact: Juan Govea C. Email: jgovea@africamsafari.com.mx

SALTILLO
Museo del Desierto
Prol. Pérez Treviño 3745
Parque las Maravillas, C.P. 25015
Saltillo, Coahuila, Mexico
PH: (+52-844) 986 90 00
FX: (+52-844) 986 90 00
Arturo González González, Director General Email: direccion@museodeldesierto.org , arteconciencia@yahoo.com PH: x 104, 105
Fernando Toledo González, Gerente de Fauna Email: ftoledo@museodeldesierto.org , fernandotoledo8@gmail.com PH: x 224, 207

SONORA EC
Centro Ecológico de Sonora (IMADES)
Comisión de Ecologia y Desarrollo Sustentable Estado de Sonora (CEDES)
Reyes y Aquascalientes esq. Col. San Benito
Hermosillo, Sonora
PH: (+52-622) 250-1225 or 250-8490
FX: (+52-622) 250-8490
Contact: Director Sr. Jose Francisco Ortega Molina Email: jortega@cedes.gob.mx
Records: Alejandro Ingio Gelain Email: aiglain@msn.com

TAMATAN (ISIS mnemonic ***TAMATAN Z***)
Zoológico de Tamatán
Calle Úrsulo Galván #250 esq. Río Bravo
Col. Tamatán
87060 Cd. Victoria, Tamaulipas
PH: (+52-834) 318 14 92 / 312 00 86
FX: (+52-834) 312 00 86
Contact: Dr. Vincente Mongrell Baviera Email: vicente.mongrell@tamaulipas.gob.mx
Contact: Roberto Wolf Email: rwolf@zootamatan.org robert.wolf@tamaulipas.gob.mx
Rwolf.zootamatan@correomex.net PH: (+52-834) 318 1492 x 36 97 Cell: (+52-834) 116 06 83

TOLUCA
Zoológico de Zacango
Comisión Estatal de Parques Naturales y de la Fauna (CEPANAF)

Av. José Vicente Villada #212, 4o. Piso
Col. Centro
50000 Toluca, Edo. De México
PH: (+52-722) 214 99 19
FX: (+52-722) 213 03 75
Director: Ing. Jorge Rescala Pérez Email: cepanaf@mexico.com
Technical Contact: M.V.Z. Jesús Frieventh Mondragón Email: cepanaf@mexico.com
Mexican Wolf Contact: M.V.Z. Guillermo Díaz Díaz Email: gdiazdiaz@hotmail.com

U.S. FACILITIES

ALAMEDA
Steve Diehl
Alameda Park Zoo
1376 East 9th Street
Alamogordo, NM 88310
PH: 505-439-4290
FX: 505-439-4103
Email: sdiehl@ci.alamogordo.nm.us

ASDM TUSC
Shawnee Riplog-Peterson
Arizona-Sonora Desert Museum
2021 N. Kinney Road
Tucson, AZ 85743-8910
PH: 520-883-3064
FX: 520-883-2500
Email: sriplog-peterson@desertmuseum.org

BATTLE CR
Jenny Barnett
Binder Park Zoo
7400 Division Dr.
Battle Creek, MI 49014
PH: 616-979-1381; ext.158
FX: 616-979-8834
Email: jbarnett@binderparkzoo.org

BISMARK
Terry Lincoln
Dakota Zoo
P.O. Box 711
Bismarck, ND 58502-0711
PH: 701-223-7543, ext. 4
FX: 701-258-8350
Email: director@dakotazoo.org

CARLSBAD
Holly Payne
Living Desert State Park
P.O. Box 100 (1504 Miehls Drive)
Carlsbad, NM 88220
PH: 505-887-5516
FX: 505-885-4478
Email: holly.payne@state.nm.us

CHICAGOBR
Joan Daniels Tantillo
Brookfield Zoo
3300 Golf Road
Brookfield, IL 60513-1095
PH: 708-485-0263, ext. 436
FX: 708-485-3532
Email: joan.daniels@czs.org

CINCINNAT
Doug Feist
Cincinnati Zoo and Botanical Garden
3400 Vine Street
Cincinnati, OH 45220-1399
PH: 513-569-7750
FX: 513-569-8213
Email: doug.feist@cincinnatizoo.org

CLEVELAND
Alan Sironen
Cleveland Metroparks Zoo
3900 Wildlife Way
Cleveland, OH 44109-3132
PH: 216-635-3373
FX: 216-635-3373
Email: als@clevelandmetroparks.com

CLOVIS
Herschel Arnold
Hillcrest Park Zoo
P.O. Box 760
Clovis, NM 88101
PH: 505-769-7873
FX: 505-769-4800
Email: harnold@cityofclovis.org

COLO SPRG
Tracy Leeds
Cheyenne Mountain Zoological Park
4250 Cheyenne Mountain Zoo Road
Box 158
Colorado Springs, CO 80906-5755
PH: 719-633-9925, ext. 113
FX: 719-633-2254
Email: tbrower@cmzoo.org

COLUMBUS
Dusty Lombardi
Columbus Zoological Garden
P.O. Box 400 (9990 Riverside Drive)
Powell, OH 43065-0400
PH: 614-645-3458
FX: 614-645-3465
Email: dusty.lombardi@columbuszoo.org

DIVIDE
Darlene Kobobel
Colorado Wolf and Wildlife Center
P.O. Box 713
Divide, CO 80814
PH: 719-687-9742
FX: 719-687-9742
Email: darlene@wolfeducation.org

EL PASO
John Kiseda
El Paso Zoo
4011 East Paisano Drive
El Paso, TX 79905-4223
PH: 915-521-1865
FX: 915-521-1857
Email: kisedajj@elpasotexas.gov

FOSSILRIM
Mary Jo Stearns
Fossil Rim Wildlife Center
P.O. Box 2189
(2155 County Road 2008)
Glen Rose, TX 76043
PH: 254-898-4235
FX: 254-897-3785
Email: maryjos@fossilrim.org

JULIAN
Patrick Valentino
California Wolf Center
P.O. Box 1389
Julian, CA 92036-1389
PH: 619-236-9060
FX: 619-236-9030
Email: patrick@californiawolfcenter.org

LADDER RH
Bill Mader
Ladder Ranch
H.C. Box 95
Caballo, NM 87931
PH: 505-895-3360
Email: desertskythunder@hotmail.com

MINNESOTA
Chris Kline
Minnesota Zoological Garden
13000 Zoo Boulevard
Apple Valley, MN 55124-8199
PH: 952-431-9383
FX: 952-431-9267
Email: chris.kline@state.mn.us

NYWOLF

Rebecca Bose
New York Wolf Center
P.O. Box 421
South Salem, NY 10590
PH: 914-763-2373
Email: rebecca@nywolf.org

NZP-WASH
Linda Moore
Animal Care
Smithsonian National Zoological Park
PO Box 37102 MRC 5507
Washington, D.C. 20013-7012
PH: 202-633-3210
FX: 202-633-8727
Email: moore@si.edu

OKLAHOMA
Vonciel Harmon
Oklahoma City Zoo
2101 NE 50th Street
Oklahoma City, OK 73111-7199
PH: 405-424-3344, ext 232
FX: 405-425-0207
Email: vharmon@okczoo.com

PALM DES
D. Peter Siminski
The Living Desert
47-900 Portola Avenue
Palm Desert, CA 92260-6156
PH: 760-346-5694, ext. 2103
FX: 760-568-9685
Email: psiminski@livingdesert.org

PHOENIX
Kara Schilling
The Phoenix Zoo
455 N. Galvin Parkway
Phoenix, AZ 85008-3431
PH: 602-914-4311
FX: 602-914-4380
Email: kshilling@thephxzoo.com

PRESCOTT
Pam McLaren
Heritage Park Zoo
1403 Heritage Park Road
Prescott, AZ 86301
PH: 928-778-4242, ext. 11
FX: 928-778-1341
Email: pmclaren@heritageparkzoo.org

RIO GRANDE
Rick Janser
Albuquerque Biological Park

903 Tenth St., SW
Albuquerque, NM 87102
PH: 505-764-6224
FX: 505-764-6281
Email: rjanser@cabq.gov

SEDGWICK
Nancy Smith
Sedgwick County Zoo
5555 Zoo Blvd.
Wichita, KS 67212-1698
PH: 316-266-8327
FX: 316-942-5228
Email: nsmith@scz.org

SEVILLETA
Melissa Kreutzian
U.S. Fish and Wildlife Service
Mexican Wolf Recovery Program
Sevilleta Wolf Management Facility
2105 Osuna NE
Albuquerque, NM 87113
PH: 505-761-4728
FX: 505-346-2542
Email: melissa_kreutzian@fws.gov

STONEHAM
John Linehan
Stone Memorial Zoo
Stoneham, MA
c/o Zoo New England
One Franklin Park Road
Boston, MA 02121-3220
PH: 617-989-2054
FX: 617-989-2025
Email: jlinehan@zoonewengland.com

SWREF
Linda Searles
Southwest Wildlife Rehabilitation and Education Foundation Inc.
8711 E. Pinnacle Peak Road #115
Scottsdale, AZ 85255
PH: 480-471-9109
FX: 480-471-0956
Email: lindasearles@gorvw.net swref@extremezone.com

UTICA
Mike Bates
Utica Zoo
99 Steele Hill Road
Utica, NY 13501
PH: 315-738-0472
FX: 315-738-0475
Email: mike.bates@uticazoo.org

WCSRC

Susan Lyndaker Lindsey
Wild Canid Survival and Research Center
P.O. Box 760
Eureka, MO 63025-0760
PH: 636-938-5900 *or* 6490
FX: 636-938-6490
Email: slindsey@wildcanidcenter.org

WILD WNP
Roger Alink
Wildlife West Nature Park
P.O. Box 1359
Edgewood, NM 87015
PH: 505-281-7655
FX: 505-281-7170
Email: wildlife@swcp.com

WINDOW RO
Matthew Holdgate
Zoo Curator
Navajo Nation Zoological and Botanical Park
Department of Fish and Wildlife
P.O. Box 9000
Window Rock, AZ 86515
PH: 520 or 928-871-6574
FX: 520 or 928-871-6644
E-mail: mholdgate@navajofishandwildlife.org

WOLFHAVEN
John Blankenship
Wolf Haven International
3111 Offut Lake Road
Tenino, WA 98589
PH: 360-264-4695 or 800-448-9653
FX: 360-267-4639
Email: director@wolfhaven.org

WCS MN
Peggy Callahan
Wildlife Science Center
5463 W. Broadway
Forest Lake, MN 55025
PH: 651-464-3993
FX: 651-464-6768
Email: peggy@wildlifesciencecenter.org

FREE RANGING IN THE WILD

Blue Range Wolf Recovery Area
Contact information same as Sevilleta